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ORIGINAL ARTICLES

THE EVIL EFFECT OF ADENOIDS AND TONSILS UPON THE DENTAL ARCHES

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THE word "orthodontia" is not exactly descriptive of our science, in fact it only describes a part of what is really attempted, and covers only partly what is accomplished. We not only treat the malposed teeth, but also correct the deformities of the jaw, and the associated structures together with the complete, or partial correction of obstructed nasal cavity. The nasal and oral cavities, being so closely associated in normal conditions, what affects one, will also affect the other more or less. When we speak of the correction of malocclusion, we mean the correction of abnormal conditions associated with the teeth, which may be the teeth, arches, jaw, nasal cavity, or muscular, and atmospheric pressure.

During the past few years, a large number of articles dealing with malocclusion have called attention to the fact that mouth-breathing is a very important factor in the production of these deformities. The cause of mouth-breathing has not been given as much attention by the dental profession as it should have received, and therefore this paper will deal primarily with the direct results of adenoids and tonsils, and conditions associated with them. In speaking of adenoids and tonsils, we may state that they include a group of lymphoid tissues, located in the pharynx. This lymphoid tissue has received considerable attention from the medical profession in times past, and has been recognized as such a prolific source of infection that it has been called the "vicious circle."

The lymphoid tissue located in the pharynx may be termed a circle because certain masses are located in the different parts of the pharynx, con-

nected with lymph channels in such a manner as to form a complete chain of lymphoid tissue surrounding the nasal and oral pharynx. These masses of lymphoid tissue have been named tonsils by the anatomist, although the lay public when speaking of tonsils generally only include that mass of lymphoid tissue located in the oral pharynx, between the anterior and posterior pillars of the fossae.

The adenoids proper are a mass of lymphoid tissue located in the nasopharynx just posterior to and above the soft palate at a point corresponding to the base of the sphenoid bone. This mass of lymphoid tissue has also been called the pharyngeal tonsil, because of its location in the nasopharynx. It is composed principally of this mass of soft lymphoid tissue, and has a very small connective tissue covering, and consequently is the softest mass of lymphoid tissue found in the pharynx. It has been named adenoid tissue, because it so closely resembles a glandular structure, but it is not truly a glandular tissue. This lymphoid tissue is present in every child and only when it becomes sufficiently large to project forward does it come in contact with the soft palate, and thereby becomes a pathologic factor in the production of mouth-breathing.

If the lymphoid tissue, or adenoids located in the nasopharynx becomes sufficiently large to obstruct the nasal respiration, the individual immediately becomes a mouth-breather. As a result of the production of mouth-breathing the adenoid tissue becomes a potent factor in producing a series of deformities through lack of development, which is noticed in a large number of individuals who are chronic mouth-breathers. It must be remembered that the adenoid tissue located in the nasopharynx is the most prolific cause of mouth-breathing in children, and the large number of maldevelopments that follow. They also are produced by a series of changes, which are brought about by mouth-breathing regardless of the cause. In order for the nasal and oral cavities to develop as they should we must have normal conditions, known as the forces of occlusion, one of which is normal atmospheric pressure, and another normal muscular pressure. In the normal individual during normal respiration the lips are closed, and the air passes through the nasal cavities, and exerts force upon all the walls of the nose. The force exerted upon the walls in nasal-breathing causes a normal development of the nasal cavity, which includes a downward growth of the roof of the mouth, and thereby causes a proper development of the nasal septum.

During normal breathing the mouth is closed, and the tongue occupies the whole of the oral cavity with the exception of a small space between the central portion of the tongue, and the extreme posterior part of the roof of the mouth. The back portion of the tongue is in contact with the soft palate, therefore producing a vacuum between the base of the tongue, the soft palate, and the lips in front, which is for the purpose of holding the mandible in proper position. In normal breathers, the mandible is not closed by muscular effort, at least, it is not kept closed by muscular effort, but held in position by atmospheric pressure resulting from the vacuum produced between the palate and the tongue.

We will observe in normal breathers that the mylohyoid muscles to a certain extent do not drop directly from their origin at the mandible, but are in a more or less right angle arrangement due to the fact that atmospheric pressure holds the soft tissue under the tongue up against the tongue, and thereby gives a square appearance to the mandible. In mouth-breathing the mylohyoid muscle and the tissue under the tongue drops downward, resulting in a diagonal line being formed between the point of the chin and the hyoid bone.

In mouth-breathing, we lose the normal force of atmospheric pressure during respiration, and we lose the normal action of the tongue in these developments of the dental arches, and the restraining influence of the upper and lower lip on the anterior teeth, which result in a series of deformities developing which may be described as follows:

In mouth-breathers we find the upper dental arch does not develop laterally as it should, and consequently remains in a narrow condition.

In addition to the lack of development we also find there is a lack of downward growth from the roof of the mouth, which results in the roof of the mouth being too close to the roof of the nose.

As a result of this, the nasal septum does not have sufficient room to grow downward, and consequently in a large number of cases becomes deflected in the form of the letter *S* presenting one or two curvatures from above, downward.

The mouth being held open, there is no restraining influence exerted upon the upper anterior teeth, and consequently there is a tendency for them to protrude, and this protrusion is further assisted by the fact that the lower lip falls between the upper and lower teeth in such a manner as to assist in forcing the upper incisors forward.

As soon as the individual becomes a mouth-breather the mandible is held open, as a result of which the muscles of the mandible exert a downward pull upon the mandible, which retards the development of the body of the bone forward.

The lack of forward growth of the mandible very soon allows the distal relations to develop, which results in the lower arch being distal to the upper arch.

As a result of these abnormal forces of occlusion, the facial deformity and malocclusion tend to become worse as the individual grows older. In a large number of these individuals, who are mouth-breathers, we also find enlargement of the faucial tonsil, which is a mass of lymphoid tissue located between the anterior and posterior pillars of the fossa.

These are the so-called tonsils, which the public are familiar with. The faucial tonsils do not exert as deleterious an influence upon the dental arches, and do not directly produce the prolific cases of malocclusion, as do the hypertrophy of the nasal pharyngeal, tonsil, or the adenoid tissue, because of the fact that they themselves do not produce mouth-breathing. We find, however, that inflammation of the faucial tonsil in young children is very apt to

produce a different type of malocclusion, than that which is produced in the typical mouth-breathers.

Dr. Angle called attention to the fact several years ago that a large number of children suffering from the condition known as mesioclusion, were found to be suffering from an inflammation of the faucial tonsils. Inflammation of a faucial tonsil may be conducive to mesioclusion, by the fact that children who have inflammation of this mass of lymphoid tissue, may unconsciously protrude the mandible, and consequently relieve the pressure upon the inflamed organ. As a result of this voluntary protrusion of the mandible, it becomes possible for the teeth during process of eruption, to become locked mesial to the superior maxillæ teeth, and consequently a case of mesioclusion will develop.

We do not claim that all cases of mesioclusion are produced by enlarged or inflamed faucial tonsils, but it is probably a factor in the production of the majority of these conditions. It has also been found that in individuals who have a chronic inflammation of the faucial tonsil, a large number of them may also be sufferers of other constitutional conditions, one of which may be rickets. Science also proves that rickets is capable of producing bone deformity, and as a result of this change, the mandible is liable to assume such positions as is characteristic of mesioclusion cases. You can therefore readily see that if the child is rickety, and also suffers from enlarged faucial tonsils, the chance for the development of a bad case of mesioclusion is more likely than in the individual who is not suffering from these conditions.

The evil effects of the diseased tonsils upon the dental apparatus, as well as upon the development of the nasal cavity must be given consideration by everyone engaged in the practice of dentistry and medicine.

A SYSTEM OF ORTHODONTIC RECORDS*

By Carl O. Engstrom, D.D.S., Sacramento, Calif.

CONSIDERING the recent advent of orthodontia as a profession, its rapid growth, its great influence in the promotion of personal efficiency and its future prospects, a system of records adopted and used by all members will no doubt redound to the mutual advantage of all concerned as well as to the advancement of the science. Most professions have some standard outline for recording their work. Their use has been of great value in the compilation of statistical reports and many deductions and discoveries pertaining to scientific subjects have resulted from well arranged systems of tabulated facts. In research and in study of subjects like orthodontia demanding observation, comparison, and deduction, they are a most important adjunct. The need of a system of records was evidenced by the action of the American Orthodontia Society when they appointed in 1916, a committee to report at a later meeting on a system of records. Why no standard form for records has been adopted by the orthodontic profession may be due to the many personal ideas as to just what should constitute a practical system of records. Then again, but a few years ago, practically a sole dependence on the workings of some system of appliances necessitated only such records as models and photographs of patients before and after treatment. Since that time a better understanding of the laws of nature has so altered our former ideas that a system of records in detail is becoming an evident necessity and without some definite outline to follow they become but a great mass of scattered information of little practical value. Many of the questions regarding these laws may be answered by deductions from reports of a number of cases. Then again, with the facts now known regarding the laws of nature in orthodontia and the means used in treatment, and wherein every case is treated according to the conditions peculiar to itself, how much can one mind remember of what was done in but a month past on all, say fifty cases? What then of the scientific value to be gotten from the explanation of past treatment of any one case, wherein memory is the only means of verification? While veracity and achievement are not to be questioned, scientific results must be based on known recorded facts and there is no better means for satisfactory substantiation of results than records in detail made at the time of the execution of the work.

It has well been said orthodontia is enough to tax the greatest of minds. Records are the memory of facts that should not be a burden where more essential knowledge should be. In treatment it is ofttimes of advantage to refer to past treatment or to treatment of other cases and therein records present considerable worth. As a means of comprehensive description of previous treatment, a record in detail will save time and much correspondence in the transfer of a case by one orthodontist to another and thereby a correct appreciation of such treatment may be gained. A more correct appreciation of the study, work, time employed, and compensation may be gained by the use of records in detail. While this naturally necessitates some work, much time and

*Read before the Pacific Coast Society of Orthodontists, San Francisco, Calif., February 18, 19, 1918.

work may be saved otherwise in the treatment, and if not, the effort will at least be commensurate with the increased efficiency of the operator or with the assistance which may be given the promotion of the science.

In a systematic record it is desirable that it be efficient and this may be stated as the serving of a three-fold purpose; as an outline of facts of interest to the profession, facts of interest to the operator, and facts of interest to the patient. It is desirable that it be comprehensive in detail, simple in arrangement for perspicuity and practical in ease and quickness of handling and notation. It is desirable that it be of such arrangement that additional data may be easily added and yet not be voluminous. It is desirable that it be a means of readily depicting necessary data, and also, it may be stated, a means of recording such data and leaving to the option of the operator a more extensive exposition of facts.

The system of record cards to be presented are the result of years of study of some practical means of keeping records in detail. Some years ago the writer presented to this society, cards whereby a diagrammatic record might be kept. The present system includes this same means of diagrammatic presentation. A number of the leading orthodontists of this country have used and are using this card and the writer desires at this time to tender thanks to them for their hearty cooperation in suggesting changes and in their approval of the present form.

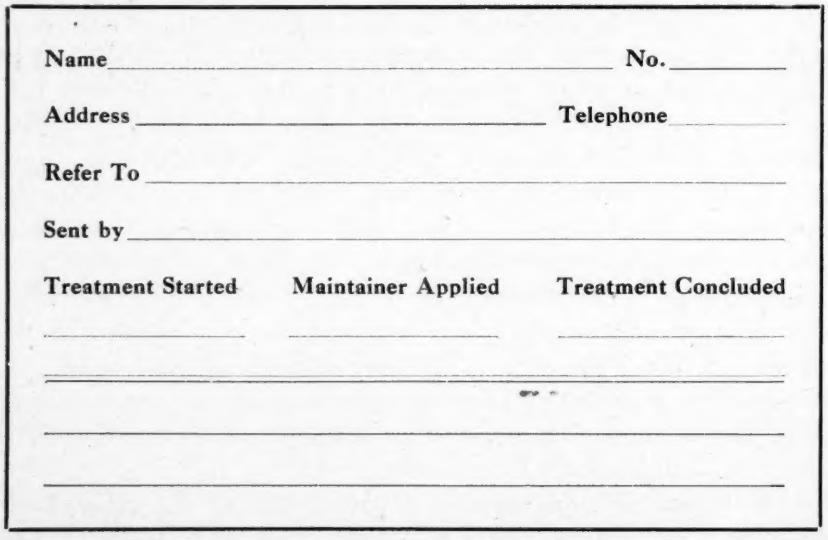

Fig. 1.—Three-leaf folder, showing outside flap. The actual size of the folder, when folded as above, is eight inches wide by five inches high.

This system consists principally of a folder and two cards, one for the facts of the case as presented and the other for notation of treatment.

The folder is what is known as a three-leaf folder and is of such shape and size that it may be easily handled in examination and in transferring and will accommodate all notes, photographs, radiographs, etc. On the outside of the folder (Fig. 1) an outline is provided for such matter as may be of importance in the identification of the case and which may be of use for ready reference.

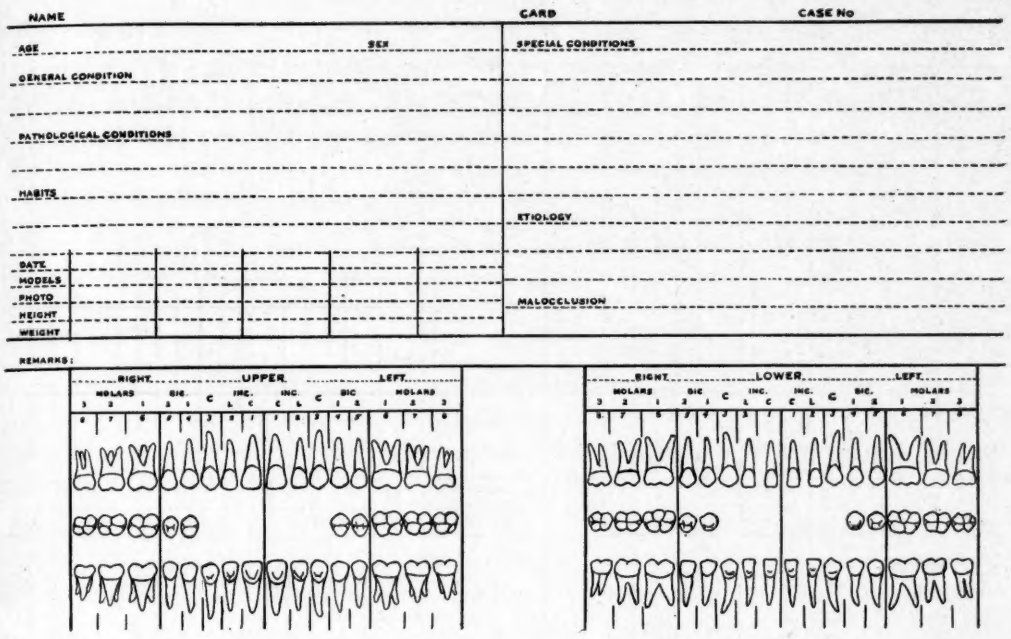

Fig. 2.—Face side of first card. The original from which this cut has been made is printed in two colors (red and black) and is eight by five inches in size.

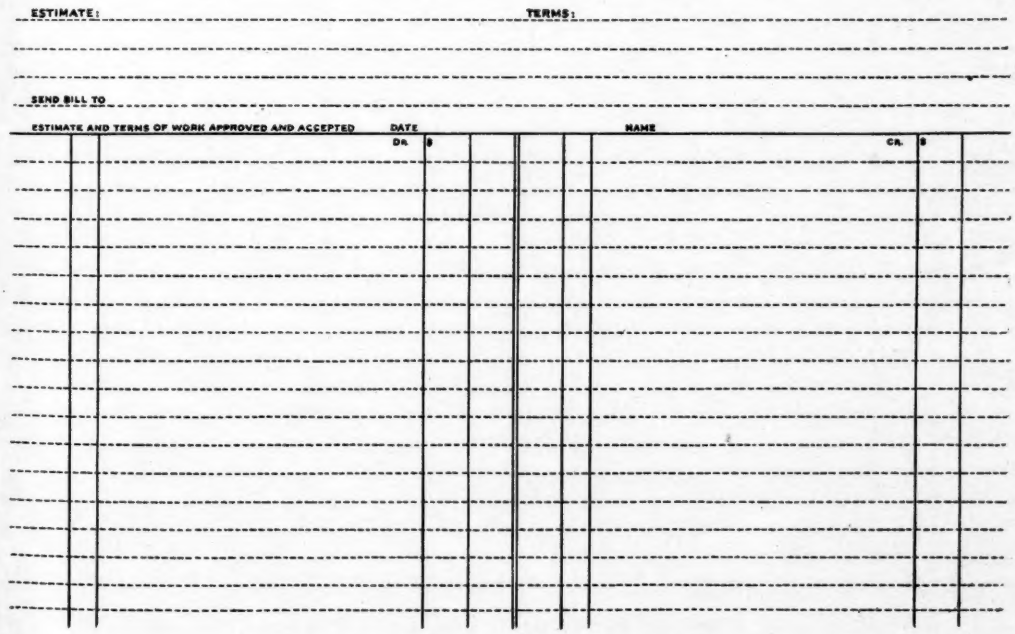

Fig. 3.—Reverse side of card shown in Fig. 2.

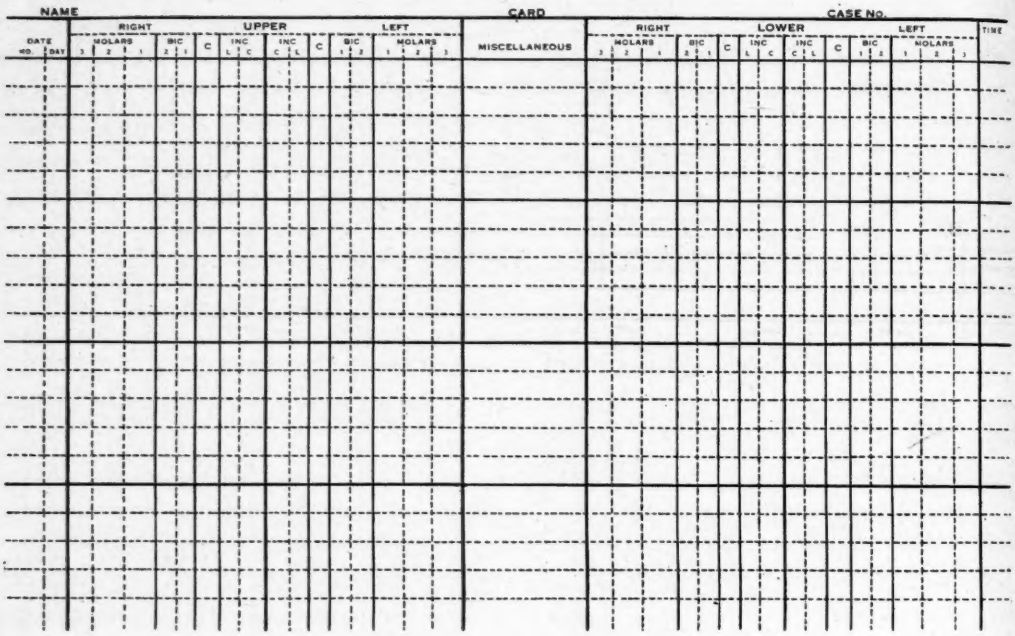

Fig. 4.—Second card, which is the treatment record card.

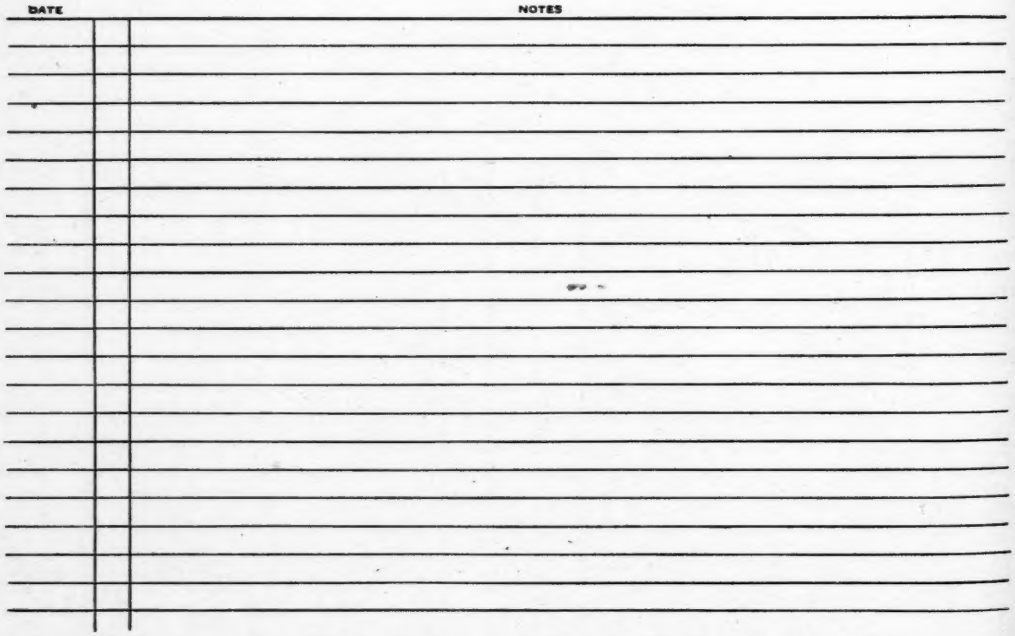

Fig. 5.—Reverse of treatment card shown in Fig. 4, with lines provided for notes.

For distinctiveness and neatness this is best typewritten. Here is written the name of the patient, the number of the case, the address of the patient, the telephone number, the name of the party to whom to refer, and the name of the person who sent the case. Of the last two notations if the former be a relative, such relation is stated in parenthesis, and if the latter be a dentist, physician, or former patient, that is likewise added. Below this is written the date of commencement of treatment, the date when maintainers are applied, and the date of conclusion of treatment. Under this are the lines for the entry of notes, such as those regarding time of appointment, conclusion of treatment, and result of treatment, etc.

On the face side of the first card (Fig. 2) spaces are provided for facts of the case as presented, these being only those of material value in treatment, and on the other side (Fig. 3) is provided an outline of the agreement, and the credit and the debits. As a means of record of questions and answers a list of same may be kept aside from the cards. That is a matter of desirability and knowledge of the operator and to be determined for himself. At the top of the first card, space is provided for the name of the patient, the contents of the folders, and the number of the case. Photographs, radiograms, may be designated by letters, and cards and other notes by numerals, so that all contents may be recorded. Below this are headings, such as age, sex, general conditions, pathological conditions, habits, special conditions, etiology, malocclusion, and as stated before only factors of value in treatment are herein recorded under these respective headings. Spaces are set apart for record of models, photographs, height, and weight at noted dates. Below this is a line for remarks.

The lower portion of the first card (Fig. 2) contains diagrams of the full dentures for the record of condition of teeth and mouth. The upper denture is on the left and the lower on the right of the center of the card. Additional notes may be entered regarding the examination and condition of the mouth and teeth in the spaces to the left and between the diagrams. It will be noted that the surfaces of the teeth are presented in the manner of examination. First, facial, then occlusal, then lingual. As entire teeth are presented, conditions of gums, crowns, and roots may be entered by drawings, signs, etc. Average measurements of teeth were used and reduced to fit the size of the card. At the lower border of this side of the card are vertical lines representing the position of contact points and also setting off the respective widths of the teeth. This will be alluded to in the description of the second card.

On the other side of the first card (Fig. 3) is a form to be filled out regarding the financial agreement and when signed by the responsible party makes it legal, without such appearance, as well as a valuable note to which to refer; hence, no misunderstanding can arise through forgetfulness. Below this is the form for debits and credits.

The second card is the treatment card proper (Fig. 4). At the top, the name of the patient, the number of the card (corresponding number being entered at the top of the first card), and the number of the case may be placed. On the face side of the second card are vertical lines corresponding with those at the lower border on the face side of the first card. Horizontal lines divide the card into twenty spaces and on each of these lines spaces are provided to left

of the card for entry of the date, and to the right spaces are provided for notation of time. This arrangement allows for drawings, showing the detail of appliances, bends, wires, position of spurs, etc. In the center space is provided for short notes and printed in this space at the top of the card is the word, "Miscellaneous." It may be observed that the vertical lines may be continued by additional cards. On the other side of the card (Fig. 5) lines are provided for notes.

A record of treatment may be made on this second card in either of these two ways, by drawings and abbreviations or by drawings and a verbal exposition. The first represents practically a full diagrammatic presentation. Time of appointment is entered to the left of the card, service rendered placed in its respective place or places and the time involved in treatment placed to the right of the card. Movement of teeth may be signified by symbols, as the spear, or by letter. When more than twenty appointments are required, another card for twenty more is added. Miscellaneous notes may be placed on the other side of the card. A list of all symbols in the use of this method should be made on the inside of the folder or on another card. By this method appliances and movements of each and all of the teeth may be seen at a glance. What was done at each appointment and time consumed is most clearly presented. By the other mentioned method of recording drawings are made of the appliances on the face of the card. All changes of appliances are recorded with their respective dates. The movements as intended are specified in words on the side of the card reserved for notes. This method may be as easily understood by others as by the operator.

In order to thoroughly appreciate a system of keeping records in detail, they should be used in practice and whatever of detail is recorded, it will be found to be of considerable value, but the more detail that is clearly recorded the more useful the system becomes, and this as stated before is a matter contingent on the personal knowledge of orthodontia in all its branches of study.

It will be noted that a great deal of information may be recorded by this system, that practically all space is used and yet an orderly outline is provided that is simple, comprehensive, easily understood and manipulated.

DISCUSSION

Dr. John M. McCoy.—There is no question but Dr. Engstrom has presented something really worth while, and his paper is deserving of our consideration. The value of the standardized record is obvious. When you consider that in our work the treatment at times extends over so great a period that our patients are referred back and forth, and as a rule a very meager record of the case goes with the patient, there is no question but this lack causes a great hindrance in the continuation of treatment necessary. To show how inconsistent most of us have been in the past, we will spend hours and hours of time in taking casts and trimming models beautifully, and then the record of the case is made in a few seconds or minutes, and we depend on our memory in most instances, and that is certainly not dependable in my case at least.

Years ago I devised a system of records myself, and while it has been of some help to me it is, I know, incomplete, and Dr. Engstrom's method is certainly very complete and will help us in standardizing our records. I congratulate Dr. Engstrom on his presentation of this subject.

Dr. Solley.—Mr. President and Gentlemen: Today we are moving along the lines for a standardized nomenclature. It seems to me, as Dr. McCoy has said, that a standard-

ized record data is just as important, especially when our patients go from one man to another. If we could send these records to the other man, how much easier it would be for him to carry on the work. I have used Dr. Engstrom's cards about three years. I like particularly the idea that whenever you band a tooth you mark it on your card, and no matter how many cards you have you can always see exactly what you have done. The cards are very easily kept in a small desk file, close at hand. The backs of these cards are extremely useful for recording all data in the way of letters you have sent parents, or special instructions you have given in oral hygiene. I think we are too lax in keeping records of various instructions we give our patients, and if any of us are unfortunate enough to be called in court, any specific written data on the back of your cards will stand you in good stead. It is the best evidence as to any instructions you may have given your patients.

Dr. Engstrom.—In response to Dr. Cavanagh's suggestion as to some method for recording erupting teeth in lieu of removing appliances and making casts, I believe it would be well to mark the deciduous teeth and permanent teeth in place when you start. As the case develops, and for instance a central incisor is removed, you make notation of the date, and when the permanent central incisor erupts you follow down the column and find the "extraction" and "eruption" at this date, etc.

LOCAL AND SYSTEMIC EFFECTS OF MALOCCLUSION*

By Varney A. Kelley, D.M.D., Seattle, Wash.

THE subject of this paper is one of far-reaching possibilities. The difficulties encountered in treating the subject lie in selecting the most important and interesting points, not in finding sufficient material to consider.

I do not want any one to think that I consider the points I attempt to bring out as new, for I well know they are not. All I can hope to do is to give a sort of a resume of the things you already know, hoping some of you will be able to derive some benefit therefrom.

Under the local effects of malocclusion the first thing to enter our minds is the personal appearance. How many of you are there who have not seen people who seem very attractive while their face is in repose and who, upon talking or smiling, are changed by the display of a very irregular set of teeth to an unattractive person, and the reverse is also often encountered that a very plain person, while in repose, will, upon the display of a regular set of teeth, become almost attractive to look at.

We all know that upon acquaintance, it is the real man or woman that counts and not the looks, but we must also admit that until we have had an opportunity to become acquainted, one's facial expression and personal appearance has much to do with the confidence we feel we can repose in them. Looking at the matter from this angle it is easy to see the effects that malocclusion has in influencing one's opportunities in life. In the business world today, where there is so much competition, there can be little dispute that a pleasing countenance is a big asset.

So much for the physical personal appearance; now, I want to touch for a minute on what I will, for the lack of a better classification, mention as the mental appearance, by which I refer to the intellectuality as expressed in

*Read before the King County Dental Society, Seattle, Wash., April 2, 1918.

the countenance. Occasionally, we see people with irregular teeth who have a very bright, intelligent countenance, but this is the exception that proves the rule, for I think it is almost invariably the case, that a person with malplaced teeth, especially with constricted arches, has a stupid and absent-minded look that is a serious handicap to them, especially in the earlier stages of their business career, and I am firmly convinced that their intellectuality is not what it normally should be. In my limited experience, it seems that nearly every case that has come under my care, where the arches were narrow shows not only to me but to the parents, upon expansion, a marked improvement in their ability to apply themselves to their studies and this improvement begins to manifest itself in an incredibly short time. In one particular instance a lady presented her niece for treatment, the little girl was a bright appearing person and yet when studying her closely showed a sort of absent-mindedness and after I had the appliances adjusted, I remarked to the aunt that in three or four months she would notice a difference in the girl's mental ability, and she smiled as much as to say "The same old stuff." In two and a half months she came to my office alone and said she had come to apologize to me for thinking me over enthusiastic in my work, that she had always considered Marion a very bright girl, but that morning she had been talking to her teacher who remarked on the late improvement in Marion's school work and the aunt said she had never seen her accomplish so much in her music as she had in the past two or three weeks. Now this is not an exceptional case but is only a fair sample and is a phase of the work that I feel should be considered very seriously in connection with this branch of our work. If a child can apply himself so much better to his work, it must needs follow that the efficiency of the adult must be increased in an even greater proportion.

Another result of malocclusion is the receding chin, we can all recall some one whom we know, whose personal appearance is greatly impaired by this misfortune and yet this is one of the irregularities which is entirely and easily remedied if taken at an early age.

To me it has always seemed difficult to differentiate between cases of malocclusion caused by obstruction of the normal breathing by adenoids and cases of adenoid growth caused by constricted arches but I think there are many cases of adenoids that would be greatly improved if not entirely cured by the expansion of the arches. I am strongly in hopes the day is not far distant when our brother practitioners will recognize the important part normal occlusion plays in the success of their operations and will be more inclined to advise their patients to consult their dentist in regard to the matter.

Under the systemic effects of malocclusion it is very difficult to say where to begin and where to leave off so closely interwoven is ill-health with an unsanitary mouth, caused by teeth in malocclusion, and so irregular that it is practically impossible to keep the teeth in anything approaching a sanitary condition.

In the regular practice of dentistry, our one aim is to prevent decay and to produce as perfect occlusion as possible, recognizing the fact that in proper

occlusion only lies the possibility to properly masticate the food which produces the energy that runs the human machine.

We all know that the proper adjustment of the carbureter is necessary to prepare the gas for running the gas engine and it is far more important to have the proper adjustment of the teeth to prepare the food for the human system, and we all know well the results on the digestive tract when the food is taken into it in a half masticated condition.

Under the heading of both local and systemic effects in my mind comes the extraction of teeth to make room in crowded arches.

Nature makes no mistakes in the shape and sizes of the teeth to have them harmonize with the rest of the face and anything that is inharmonious is caused by some obstruction to the natural development. In all cases when the teeth are put in their proper positions their planes will be found to give the ideal masticating service that nature intended they should and after nature has had time to build up the new tissue around the teeth in their new positions it will be found that the size and shape of the teeth will harmonize with the shape and size of the face.

Another very important feature which can be classed as an effect of malocclusion is the impossibility to keep an irregular denture in anything approaching a proper prophylactic condition, which in its turn is so often the cause of decay, and unless these teeth are taken care of we get the usual systemic poisoning, resulting in the general impairment of the entire system.

These effects that I have mentioned are only a few of the many that I could call to your attention and of which you are all cognizant, they are what seem to me the most direct and most common effects that we all see in our everyday life.

Alumni Society of the Dewey School of Orthodontia

AT the eighth annual meeting of the Alumni Society of the Dewey School of Orthodontia, held at the Edgewater Beach Hotel, Chicago, July 30 and 31, the following officers were elected for the ensuing year: President, Dr. O. A. Oliver, Nashville, Tenn.; Vice President, Dr. E. G. Weeks, Saginaw, Mich.; Secretary-Treasurer, Dr. George F. Burke, Detroit, Mich.

The place and time of the next meeting were left for the Executive Committee to decide.

A vote of thanks was extended to the retiring officers for the impartial and efficient manner in which they conducted the proceedings of the Society. A new Constitution and By-Laws were presented, amended, and adopted.

A PLEA FOR MORE ORTHODONTIA*

By W. E. Stoft, D.D.S., Omaha, Nebr.

IN writing on this subject of orthodontia, I feel I am dealing with a specialty that is in its infancy; I feel too that this child specialty is growing in spite of the apparent neglect of its real guardians, the dentists, and is being nourished to some extent at least, by foster parents and neighbors: I refer to the physicians and the laity.

We remember that Dr. Chas. Mayo said, "The next step in preventative medicine is up to the dentist." He also said, "Orthodontia is a coming specialty, not only in dentistry but in medicine," and again, "Society is going to wield the big stick and demand orthodontia treatment."

So by way of rejuvenation along this especially preventative branch of our profession, I wish to bring forth ideas both old and new.

Progressive dentists no longer say to young patients, "Oh! better wait to see if nature won't straighten out your teeth," nor do they harp on the thumb-sucking, pacifier-sucking, lip-biting habits that were once so exaggerated as etiologic factors. The theories of inheriting the teeth of one parent and the jaws of the other and also of inheriting one jaw of the one parent and the other jaw from the other side of the house are completely exploded.

The enlightened dentist of today, recognizes malocclusion early, even in the deciduous teeth and urges treatment at once.

He also knows that the great cause of malocclusion is the lack of the development of the alveolar process and approximating tissues; sensitive deciduous teeth being an important contributing factor to this lack of development.

Mouth-breathing is known to have some sort of evil effect upon occlusion and also upon the child generally and is one of the great causes of malocclusion. On these two prime etiological factors, I wish to enlarge.

In studying the development of the human dental arch, we must recognize the factors involved. Before the teeth erupt in the infant, the arch development is due to the sucking process, after the teeth erupt, they afford a means or handle if you please for the development of the arch. As the child approaches the time for the replacement of the temporary teeth by the permanent ones, there should have occurred arch development to the extent of causing a very noticeable separation of the front teeth. If this spacing has not occured, normal development has been prevented and malocclusion is present. This is readily grasped when we consider the difference in the mesio-distal diameter of the deciduous and permanent incisors. The eruption of the cuspid is so important a feature that I want to say, that as senseless would it be for a mason to remove a misplaced key to his arch of masonry and throw it away, as it is for a dentist to extract a malposed cuspid: a collapse of the human arch is sure to follow.

Mouth-breathing is another important factor in malocclusion. The teeth

*Read before the Tri-City Dental Society, Omaha, Neb., April, 1918.

under normal conditions are arranged as we all know, in a somewhat horse-shoe shape, being influenced buccally, and labially by tongue pressure and retained by the lips and cheeks. If, as in mouth-breathing, the tongue does not afford the normal outward pressure and the cheeks are stretched somewhat, training the bicuspids and molars lingually, we have a "V" shaped arch and a protrusion of the front teeth in the upper arch; this last is due to the lack of normal lip-pressure, the lip being curled up short and functionless, as a result of the accompanying sniveling habit. Another feature of mouth-breathing and which is in a somewhat evolutionary stage, is the high vault or arch which indicates an underdevelopment of the sella turcica and therefore a crowded hypophysis or pituitary body. This pituitary body in short is the governor of internal secretions and encroachment of the walls of the sella turcica causes lowered vital resistance due to inferior functioning of the hypophysis. Therefore a suppression of the internal secretions or the excessive flow of these depending upon the nature of the crowding: Anterior lobe affects secretions, middle neck or infundibulum affects shock and nerve force, posterior lobe controls blood tone, etc.

Dr. Price told us at a state meeting a few years ago that he expanded an arch, brought down the hard palate and relieved pressure on the pituitary body and thus advanced a sixteen-year-old lad from a six-year-old sexually, to normal condition. Dr. W. E. Creath, of Ottumwa, Ia., told me of a seven-year-old girl who was menstruating at this age and was a fifteen-year-old, sexually, with hair around her vagina and under her arm, so reported by family physician. The menstruation stopped and was not repeated after four years' watching—all abnormality corrected in a very short time by no other treatment than the expanding of the arch and lowering of the palate. These cases while not enough to prove anything, give us an idea of future possibilities and a need for some research work. That there is some going on is supported by the following: Dr. Creath has for some time past been making blood tests of all his orthodontic cases and finds that in a large per cent of malocclusion cases there is an anemic condition and that the correction of the malocclusion always raises the red cell count, changes the polymorphonuclear cells and increases the number of eosinophilous; also increases the number of bone marrow cells, in most all cases bringing it up to normal. I am able to add a little testimony to these facts as I have had Dr. Gerald, bacteriologist of the Creighton Dental College make some tests and while I realize that this does not prove anything very conclusively, yet there is no doubt something very interesting about it. Out of twenty new patients who started to have their teeth regulated last year, I have figures to show that every case in which the teeth were brought into fairly good occlusion, there was a decided increase in the red cell count even in those cases which were about normal in the beginning. I noted this fact too, that the red cell count corresponded to the degree of masticating efficiency.

The following table compiled from blood examinations of orthodontic cases at the Creighton Dental College Infirmary, shows what took place in a school year of thirty-two weeks in these patients.

ORTHODONTIC CASES—RED CELL COUNT—1916-17—1918-18

PATIENTS	SEX	AGE	BEGINNING	CORRECTED
1.	F.	16	3,392,000—	4,560,000
2.	F.	13	3,632,000—	4,600,000
3.	F.	12	3,680,000—	4,896,000
4.	F.	15	3,808,000—	4,784,000
5.	M.	12	3,888,000—	4,768,000
6.	F.	14	3,904,000—	4,512,000
7.	F.	13	4,064,000—	4,848,000
8.	M.	14	4,080,000—	5,040,000
9.	M.	11	4,144,000—	5,120,000
10.	M.	15	4,400,000—	4,624,000
11.	F.	11	4,608,000—	5,024,000
12.	M.	15	4,512,000—	5,040,000
13.	F.	13	4,720,000—	4,800,000
14.	F.	13	4,736,000—	5,072,000
			57,568,000—	67,688,000
	Fourteen patients' average		4,112,000—	4,834,857
#15.	M.	12	4,080,000—	3,904,000
*16.	M.	16	3,520,000—	
*17.	M.	13	3,712,000—	
*18.	F.	14	3,824,000—	
*19.	M.	8	4,000,000—	
x20.	F.	14	4,800,000—	
			81,504,000	
	Twenty patients' average		4,075,000—	

#Occlusion disturbed in the process of correcting—not so good as when started.
*These cases started but failed to finish.
xMalocclusion only slight, no final count.

Now since the next step in preventative medicine is to be made by the dentists, let us get off well together and prevent all the malocclusion we can and correct more of the unprevented and unpreventable cases which come under our notice.

A SUMMARY OF THE CAUSES OF MALOCCLUSION, WITH SPECIAL CONSIDERATION OF THOSE THAT COME UNDER FREQUENT OBSERVATION, AND WHICH SHOULD BE STUDIED AND GUARDED AGAINST*

By Wm. B. Power, D.D.S., Seattle, Wash.

ALMOST the first question asked by a parent when bringing a child to an orthodontist for consultation is: "Can you tell me what is the cause of this irregularity?"

The etiology of malocclusion is indeed so large a subject in itself, that it sometimes takes considerable time to reply to that question with any degree of correctness, or be at all sure of the answer to the particular case at hand.

Nearly everyone who has written at all on orthodontic subjects has compiled a list of the causes of malocclusion, until the reader almost wonders what will not cause it, rather than what will.

Dr. Angle, in his seventh edition, gives in the index as causes of malocclusion, arranged alphabetically and not in their order of importance:

Abnormal frenum labium,
Cleft palate,
Degeneracy,
Disuse of the teeth,
Enlarged tonsils,
Enlarged tongue,
Extraction,
Habits,
Heredity,
Imperfect fillings and crowns,
Nasal obstruction,
Nondevelopment of teeth,
Prolonged retention of deciduous teeth,
Supernumerary teeth, and
Tardy eruption of permanent teeth.

Dr. Dewey, while agreeing with his distinguished preceptor in naming these as the causes of malocclusion, has greatly enlarged on this list, and gives in addition, in the third edition of his standard textbook:

Abnormal development,
Abnormal lip,
Acquired,
Cell metabolism,
Chicken pox, an indirect cause,
Children's diseases, an indirect cause,
Congenital,
Diseases of the ductless glands, an indirect cause,
Environment,

*Read before the King County Dental Society, April 2, 1918.

Faulty development,
Family traits, an indirect cause,
Improper feeding of babies,
General or constitutional,
Harelip,
Improper diet,
Intermarriage of races,
Measles, an indirect cause,
Missing teeth,
Mixing of types,
Mouth-breathing,
Diseases of the pituitary bodies, an indirect cause,
Racial characteristics,
Rickets,
Scarlet fever, an indirect cause,
Sore teeth,
Syphilis, an indirect cause,
Diseases of thyroid gland, an indirect cause, and
Tuberculosis.

This formidable list of possible causes proves the breadth and scope of the subject we are discussing, and each and every cause given is worthy of consideration.

To show to what an extent Dr. Brady is impressed with nasal obstructions as a cause of malocclusion, let me give his outline of the causes:

Adenoids, 45 per cent.
Failure of normal enlargement of the dental arch from lack of pressure through mastication, 45 per cent.
Loss of teeth or parts of teeth through decay; failure in contour of fillings or crowns; extractions or accident; too long retention of the temporary teeth; abnormal frenum labium; unusually large tongue (thin alveolus); supernumerary teeth; delayed eruption and imparted teeth; transposed teeth; all 10 per cent.

Exception can be taken to this arbitrary percentage of each cause, as there is no way of arriving at a scientific ratio, but certainly the percentage caused by nasal obstructions must be large when an acknowledged authority gives it as 45.

It has been my experience in many cases, to hear from the parents of children, that they were advised that the malposition of the teeth was caused by finger or lip sucking, and in a great many cases they were further told that if left alone the condition might correct itself in time.

Just think of it. Think of the responsibility placed in the hands of the dentist for the future welfare and development of the individual, and then realize how that responsibility has been so lightly accepted by giving advice so unwarranted and unsound.

It is not in the scope of this paper to dwell at length upon bad advice as a cause of malocclusion, but it is clear that a serious responsibility rests on the dentist who fails to realize the importance of correct advice, on a point fraught with such possibilities of permanent injury.

When I think that a great many rhinologists examine their cases, advise treatment and do the work necessary in their own field of endeavor, and dismiss the patient, who in a great many of these adenoid and tonsil cases, has at the time, or is in fair way of getting, a malocclusion of the teeth, without calling attention to the fact; I say I am forced to think that such operators are either derelict in their duty, or ignorant of what the condition means.

Be sure and tell the parents of the children of the dangers of nasal obstructions, and advise them to consult a rhinologist.

We all realize the urgent need of such service for many children, but the rhinologist must also fully appreciate the need of orthodontic and dental service in many cases, if their ideal is to be realized.

Dr. Pullen says in Dr. C. N. Johnson's *Text-book of Operative Dentistry:* "One of the most serious abnormal conditions with which rhinologists and orthodontists have to deal, and one as intimately connected with the disturbance of normal function and structure in the field of one as in the other, is the partial or complete loss of normal respiratory function through the obstruction of the nasal, nasopharyngeal, and oropharyngeal air passages causing oral respiration, commonly known as mouth-breathing."

"That this condition, with all of its injurious results upon the development of the bones of the head and face, the disfiguring of the features, and the undermining of the general health, is becoming more prevalent, one hardly needs statistics to show, in view of the great numbers of those afflicted with this trouble in all walks of life."

We apparently seldom think when we see a case of enlarged tonsils in a child, that the condition is apt to cause one of the most unsightly forms of malocclusion that the orthodontist is called on to remedy.

These class three cases, mesioclusion or as they are sometimes called, lantern jaw or whopper jaw, where the mandible is greatly enlarged, with the chin well forward and the lower teeth in labial instead of lingual occlusion, are caused by mechanical stoppage of the air passage resulting from pathological growths.

This compels the sufferer to seek more respiratory room by holding the mandible forward, thus giving a freer air passage and greater comfort in breathing.

An important cause to which I wish to call your attention and for which you are in many cases responsible, is first and foremost, an honest consideration of the deciduous arch.

Proper advice to parents regarding the care and development of the deciduous teeth, proper foods, well masticated, are some of the greatest aids in the development of the "growth spaces," those spaces between the deciduous teeth which are so essential to the eruption and proper position of the permanent teeth.

Rickety children, and those who have suffered from malnutrition, have as a consequence, a faulty bone development which is often seen in malformed arches.

If you do not want to treat the deciduous teeth in your practice, in all fairness and justice, send the child to someone who will do it correctly, but there are few good reasons why most dentists should not accept this class of operative dentistry, and fewer excuses when they do so accept it, for failure to operate painstakingly and conscientiously.

The loss of deciduous teeth by extraction or decay with consequent loss of space is enormous. Failure to contour fillings and too long retention of the deciduous teeth are causes which come immediately under our observation. And please be careful when extracting a deciduous tooth that is fairly well rooted, not to place the beaks of the forceps over the bud of the permanent tooth which lies in immediate proximity to the root of the deciduous tooth, for I have seen some cases where this has been done, and the permanent tooth lost, with a mutilated arch as a result.

When any tooth is lost in either the deciduous or the permanent set, a certain amount of space is lost due to the tendency of the teeth to drift or move in the direction in which there is the least support, and sometimes the entire space is closed up.

Of course, here we have a shortening of the alveolar ridge, and in consequence, a form of malocclusion not easily remedied.

Another condition of importance is the tendency of teeth or roots too long retained, to deflect the crown of the erupting tooth into a malposition. The very inclined planes of the teeth, especially of the incisors, mechanically deflect these teeth, and once locked in a wrong position, they will grow and elongate themselves in that position, and so become permanently retained there.

Sometimes a very small amount of orthodontic treatment is necessary to correct the position of these erupting teeth, and then they will grow into their normal places.

An abnormally large frenum labium causes a very unsightly appearance in the incisor region, as the nature of this muscular tissue is to act as an elastic band or wedge, and thus spread the centrals apart, and give the appearance of a missing tooth in the most conspicuous portion of the dental arch.

This condition sometimes occurs in the lower arch, but I have not seen it there with the frequency and of the size that I have found it in the upper.

The condition can be remedied early in life by a very brief treatment, which should be done by all means, as it is too important to neglect.

Supernumerary teeth are also found as a cause of malocclusion, but it seems reasonable that when this condition exists as the direct cause of the irregularity, that the application of an ordinary amount of intelligence is fifty per cent of the treatment.

Such teeth should not be allowed to remain wedged in between the permanent teeth, for if this error is made they will in many cases surely cause a condition that is anything but sightly. Like broken down roots of the temporary teeth, they take up valuable space, and nature has not allowed room

for the normal number of teeth, plus extra teeth and roots in the normal arch.

Extraction will often remedy a condition that is bad and steadily growing worse, but in any event, do not pass these teeth by in fear, and say nothing to the patient or parent about the condition, for like temporary teeth that are retained till adult life, an x-ray is sometimes necessary to aid the dentist to a proper decision in such cases.

There is no one who thinks of ruthless extraction with greater horror than the orthodontist, but a courage born of knowledge that you are right, is sincerely to be looked for if cases such as these coming under our care are to receive the attention and correction that they deserve.

Eruptive fevers, measles, etc., and general constitutional disturbances as I said earlier in this paper, are given as causes of malocclusion by nearly all of the authorities.

That they cause this condition by a disturbed metabolism is assured, and our interest lies in knowing that this is so, and consequently doing everything we can to safeguard the health of the individual.

After all, that is our great professional mission, and there are few aims in life higher or more worthy.

Without doubt the dental profession realize this more thoroughly than in former years, and it is a satisfactory sign of the times, that their efforts for greater perfection are clearly recognized and appreciated by the public, and more especially by their brethren in medicine and surgery.

THE GROWTH AND DEVELOPMENT OF THE JAWS*

By F. G. Titus, D.D.S., Centralia, Wash.

THERE are certain phases in the growth and development of the body which are constant, and belong to the realm of heredity. They are teeth, hair, nails, eyes, fingers, toes, etc., and are typical of the species to which they belong. Their characteristics are impressed upon the centrosome of the original cell, the ovum, during a long series of generations. Any deviation from the typical is called a "variation" which may be only transitory or may be somewhat constant depending upon the degree to which it is impressed by succeeding transmissions. It is the purpose of this paper to deal with the development of the normal dental arch.

Beginning with the original cell, the fertilized ovum, there is a multiplication or proliferation of the cells which are at first homogenous with no definite arrangement. Gradually the cells arrange themselves into layers, and there is a differentation as to form or the establishment of types of cells which are to play their own special part in the formation of the various tissues of the body. Then we see this mass of cells developed from a single one, arranged into three layers, ectoderm, mesoderm, and entoderm.

From the ectoderm are derived the epithelial coverings of the outside of

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the body and of the oral and nasal cavities together with the enamel of the teeth, the hair, nails, crystalline lens, and nervous tissues, etc. From the mesoderm are derived the structural parts of the body, connective tissues, blood, lymph, muscle, bone, serum, membranes, etc.; and from the entoderm is derived the epithelium of the alimentary tract, and of the glands opening into it from the pharynx to the rectum and epithelium of the respiratory tract from larynx down, etc. This list is not complete but covers the tissues derived from the various layers in general, and illustrates the great specialization of the cells of the body, all derived from the one original ovum. As this specialization of the cells of the embryo continues the embryo becomes a foetus, which if normal and true to type will possess hereditary characteristics of its species.

Just what the forces or influences are which have produced this particular type or species is summed up in the term environment. That is to say environment is a term meant to designate the stimuli or forces which have influenced morphology of this type. This includes climate, food, food supply and pathological conditions, the mode of life, habits, etc., with which the individual has been forced to come in contact for a great space of time (a great many thousands of years).

We can see evidence of this specialization in the lower forms of the infusoria; for example, the ameba, the entire individual, consisting of but a single cell, with its cell wall and contents of protoplasm, nucleus, etc. This form of life responds to stimuli without any organs of special sense; no muscle, no nerves; no eyes, ears, etc. It absorbs foods through any part of the cell wall and expells its by-product through any part of the cell wall; it has motion and travels without any special organs of locomotion.

A very interesting illustration of specialization is seen in the Perimesium with its slipper-like form, its stoma for the reception of food and flagella for locomotion. In the Rotafer, we see a splendid example of specialization with its mouth or orifice for the reception of food, surrounded with flagella as organs of prehension, and set of little rockers or crushers through which the food particles must pass before it is digested and appropriated as food.

Thus, we see the idea of specialization carried out in greater detail the farther we progress along the scale of evolution to the higher types. In the early stages of embryonic development there appears in the head end of the embryo a series of branchial arches, five in number with four clefts, one between each arch. The first arch later becomes the lower jaw and the region just in front of the first branchial arch is occupied by the oral fossa; on each side of the oral fossa there arises the maxillary process, an outgrowth from the base of the mandibular, or first arch. These two maxillary buds or arches approach each other toward the median line but they do not meet; they join the nasal processes which are an outgrowth from the anterior border of the oral fossa, one on either side of the median. Later the maxillary processes and the nasal processes form the superior or upper jaw with the ends of the nasal processes intervening.

About the sixth week of embryonic life there is a proliferation of the epithelial cells lying upon the arches which later form the upper and lower

jaws. This proliferation occurs as a thickening or ridge of epithelium which gradually sinks into the mesoblastic tissue beneath, and becomes embedded therein. There is next a process of segmentation of this embedded epithelial ridge now called a dental shelf or ledge.

Now there is a process of pushing in, of the mesoblastic or connective tissue lying beneath the segment of epithelium which in turn takes on a cupped appearance. This epithelium cap becomes the enamel organ and the mesoblastic tissue within this cap, becomes the pulp and dentine of the deciduous tooth. During this process there is a little budding outgrowth from the first epithelial cap which forms the enamel organ of the permanent tooth. Now the arch which forms the lower jaw is supported by a cartilagenous structure which plays no part in the development of the bone, and later disappears.

Bone as it is found in the human body is of two varieties: the intracartilagenous and the intramembranous. But bone is bone wherever it may be found and is formed by a process of calcification in fibroembryonic tissue deposited by the osteoblast. In the intracartilagenous bone there is first a calcification of the cartilage preceded by the arrangement of the cartilage cells in definite rows. This calcified cartilage is not bone and is later removed as the true bone is developed. The bone in both jaws is of an intramembranous character.

In intramembranous bone there is a deposit of calcareous substances by the osteoblasts in a membrane of fibroembryonic tissue. The osteoblast is found in great numbers in the deeper and more vascular layers of the fibroembryonic membranes, whether it be the membrane covering, the intracartilagenous bone or the fibrous tissues in which the intramembranous bone is formed. The process is the same.

The jaw bones are developed from the fibroembryonic tissue from the mesoblast. It is built up about the developing tooth by the osteoblasts (bone-forming) which appear at this time. Upon examination of this bone it is seen to be developing by the Haversian system. The study of the Haversian system is of the most vital interest to the orthodontist and the dentist undertaking orthodontic procedure, as it is due to the functioning of the osteoblast and the osteoclast in building up and tearing down the Haversian systems in bone, that tooth movement is accomplished.

The calcification of connective tissue produced by these osteoblasts occurs about the blood vessels, arteries, veins, etc.

This Haversian System is ever changing in structure due to the activity of the osteoblastic (bone-developing) cells and the osteoclastic, cells whose function is to tear down bone structure. The process of metabolism and catabolism is constantly in progress in bone, as it is in the soft tissue, so there is a constant tearing down and elimination of bone tissue, as well as a constant bone building in progress at all times throughout the duration of life. This process is accomplished by the extension of branches of blood vessels into the bone, about which is built the new system of concentric rings with their lacuni

and canaliculi accompanied by the tearing down of the existing Haversian systems. Thus the bone secures its nutriment and the process of growth and generation and regeneration continues. As this calcareous formation occurs the osteoblasts are caught and remain as bone corpuscles, occupying the spaces called lacuni with their tiny processes extending into the little canaliculi; thus communicating with the neighboring ones.

The appearance of the Haversian system is that of concentric rings, of lamelli of bone arranged about a central channel containing as stated, blood vessels, etc.; filling in the spaces between the Haversian system is a formation of bone called interstitial bone which is the remains of old Haversian systems undergoing the process of being removed in the formation of new Haversian systems.

All bony tissue is either compact or cancellated. The compact bone being dense like ivory, and cancellated, is spongy with interstices. The other layer of all bone is compact and the inner part is cancellated, except the shaft of the long bones, which is entirely made up of compact bone, the center of which is hollow and filled with marrow; as are also the medullary spaces found in the cancellous bone.

I have endeavored to show that all growth and development of bone (including the jaws) is dependent upon individual cell activity and that cell activity is dependent upon environment—among which food, functional activity, and habit, are predominating influences.

In all our work covered by the field of dentistry it seems to me we are but dealing with symptoms, and that the fundamental causes must be corrected before we can hope to correct these conditions, decay, pyorrhea, malocclusions, etc.

The teeth in the process of development and eruption present an appearance of having been thrown into the jaws and one wonders that they ever assume a symmetrical and regular arrangement. As the development and eruption of the teeth occurs there is a corresponding growth and development of the surrounding tissues. There should be sufficient growth of the jaws to accommodate the teeth in proper approximation as they erupt and as the time approaches for the exfoliation of the deciduous teeth and the eruption of the permanent teeth there must be a spacing in the region of the incisors to accommodate the larger, permanent teeth. If this does not occur, we find them erupting in positions out of proper alignment of the arch.

In order to promote this, there are two conditions that are of paramount importance. They are functional activity and diet. Diet heads the list. It is not my purpose to go into the subject of diet, rations and foodstuffs in this paper but it seems plain that something is wrong with our environment here in America, for, American's digestive apparatus is notoriously out of kilter. Consider the prevalence of caries, pyorrhea, and malocclusion, ulcer of the stomach, appendicitis and other derangements of the alimentary tract. Contrast the diets and bad food habits of the Americans and Anglo-Saxon peoples with that of any of the more primitive peoples and the peasantry of continental Europe where diet is coarse and frugal requiring greater functional activity

and so-called Fletcherization, which is seen to induce a normal and proper cell activity in the growth and development of the organs involved.

Tooth movement is accomplished by the transposition of the tooth in the osseous process of the jaws. That is, the pressure exerted upon the tooth being moved stimulates the activity of the osteoclasts which change the bone in the region of the tooth and as the tooth is moved the osteoblasts build up new bone to support the tooth.

This movement must not exceed what might be called physiologic limits, and there should be no soreness. Too rapid movement would excite an inflammatory condition and thus retard metabolism; also bear in mind that after tooth movement is accomplished the tooth must be maintained in position until new Haversian systems of bone are built up about the roots.

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HISTORY OF ORTHODONTIA

(*Continued from page* 387.)

By Bernhard Wolf Weinberger, D.D.S., New York City

E. MAGITOT, (1833-1897). We must look to France during the early and part of the last half of the eighteenth century for our information pertaining to dentistry. In that country, more than all the others, our science made its greatest stride and among her people we find some of our most renowned men of that period. Undoubtedly the foremost of the French dentists was E. Magitot, member of the French Academy of Science, and other prominent societies. An indefatigable worker, credited with some forty odd treatises on various dental topics, published in nearly all of the scientific journals, such as the *Journal d' Anthropologie, Archives De Tocologie, Archives Generales De Medicine, Journal De L'Anat. Et. De La Physiol, Gazette Hebdomadaire,* etc.

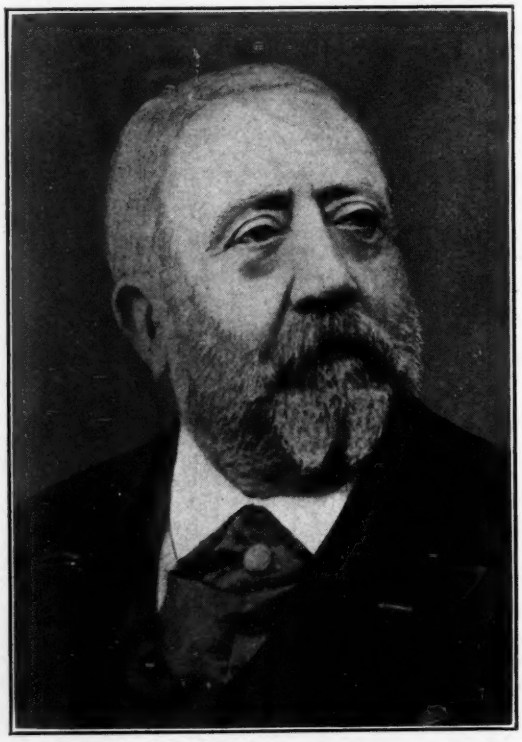

Fig. 1.—E. Magitot (1833-1897).

Anomalies of the dental system are numerous and varied and are the most important to be understood, yet up to the time of the services rendered science by the production of Magitot's work, all facts relating to this subject had to be looked for among documents scattered in every direction, there being no connection by which the literature of the subject could be traced. To Magitot the greatest credit is to be accorded, he seeing the importance of gathering this knowledge together, and combining all of the odds and ends, and what is of in-

finitely greater importance, he so arranged and classified these anomalies as to afford the practitioner at large an interpretation of them.

In 1877, twenty years after his first publication, Magitot published his great work entitled, *Traite des Anomalies du Systeme Dentaire Chez L' Homme et Les Mammiferes.* (*Treatise Upon Anomalies of the Dental System in Man and Animals.*) This volume of 305 pages and twenty plates is the most elaborate and scholarly essay upon the subject that up to that time appeared. It is an exhaustive study of the whole subject of dental variations and malformations. The author does not confine himself to his own observations, but embraces the results of the labor of others. The work is divided into nine chapters and a general introductory essay. His method is essentially the same as that employed by classical French writers, such as Isidore Geoffroy, Saint Hilaire, M. Davaine and others.

As was established by Saint Hilaire, the founder of Teratology, all troubles arising in the organization have origin in embryonic defects; it is there that the seat of disease is to be sought. The study of an anomaly existing in a given organ commences with the embryonic peculiarity. Magitot says, "With this understanding one has no difficulty in recognizing the cause for the little that is known concerning the peculiarities in the dental system."

Dental histogeny is a direction of science that has revealed its mysteries to but few. To even appreciate the labor expended in the discoveries made by Kölliker and Waldeyer in Germany and by Chas. Robin, Legros and Magitot in France cost in itself great zeal and research. What Goeffroy, Saint Hilaire has done for general teratology, Magitot has done for the monstrosities of the general system.

Magitot calls all dental anomalies deviation from the specific type. In the comparison he made between embryogeny and anatomy lies the appreciation of the phenomena associated with the diverse trouble of abnormal development, of suspension, of complete detention and of hypertrophy.

In studying morphology, Magitot found himself led to look on the dental display in the animal series as being derived from a single primordial origin. This primitive type, or dental unity, the agent principle of the second aspect, is found in a simple form in the very lowest of vertebrata. Fishes are found provided with teeth in great numbers: all more or less conoidal in shape. This is on the common principle that nature, always faithful to unity, modifies only according to requirements. In the more highly developed organisms of man the cusps of molars are recognized as modifications only of that which is the primal type. It is not, however, the case, that modifications which present in the ascending scale follow always rigorously in a zoological order. One is, however, able to say that, from a general method, the primitive type is forsaken according as the teeth diminish in number; the less the number the more complex being the form. The studies of M. Magitot are directed generally to that view of the subject which considers it from the standpoint of principles; his anomalies follow in the series of mammifera. He shows us the essential relative character. He makes us see by example that what is normality in one species is an abnormality in another; that many of the anomalies constitute in truth phenomena of return to one of the coherent halting-places, expressive of the morphologic changes of

the dental types. Pursuing farther, in man, these philosophic studies, the author is drawn to establish certain deviations seen in the dental system representative of the human species as unquestionable anomalies that take an ethnological character.

But the point, certainly the most original with M. Magitot, is that which has for its subject the "teratogeny" proper of dental anomalies, and which are divided by him, following the anatomical method into nine classes:

1. Anomalies of form.
2. " " volume.
3. " " number.
4. " " setting.
5. " " direction.
6. " " eruption.
7. " " nutrition.
8. " " structure.
9. " " arrangement.

The first in rank of the causes and laws which preside at the production of the greatest number of the dental anomalies is hereditary influences. The hereditary transmission alluded to by M. Magitot exists in that sexual affinity which may continue through generations, or which, by relation with new sexual influences may suddenly disappear; and which, assuredly in time, will disappear by reason of that natural law which of itself tends to the correction of irregularities.

As illustrative of M. Magitot's manner of dealing with his subjects, we direct attention to a few of his conclusions. "Number," he suggests, "lies in secondary buds. The irregular development of a bud explains the anomaly by numerical augmentation; absence of a bud explains absence of a tooth." Deviations in setting "Magitot" attributes to simple displacement of a tooth on the jaw, or in the neighborhood of the unrolling epithelial migration of the membrane forming its cyst. The great difference in jaws leads Magitot to discuss as a prominent feature in teratogeny certain deviations in the epithelial structure, which deviations allow of the development of a tooth after that same manner in which neoplasms come into existence, namely, by the migration of tissues from neighboring parts.

Apropos of the anomalies of structure, M. Magitot advances a very interesting question, namely, that the corrosive markings of permanent teeth, congenital alterations in shape, furrows, indentations, etc., often considered, most wrongfully, as a pathognomonic sign of predisposition to certain diseases, the hereditary syphilis, for example, are to be esteemed as indelible and permanent traces of invasions of infantile affections, especially convulsions. If this inference, based on a certain number of facts, but still contested, is found verified, the hypothesis put forth by Broca, that the prehistoric trepanations of children affected with convulsions was for the purpose of permitting the escape through the opening in the skull of a malicious spirit, may be accepted as the true one.

Magitot describes, in treating this subject, three methods of applications according to three phases, as follows:

1. The anomalies embryonic in origin, which include the deviation of position and number.

2. The anomalies of nutrition. Those forms, represented by the form, by volume and by structure (intrafollicular with odontomis and cysts).

3. Anomalies of development, eruption, direction and arrangement.

A synopsis of Magitot's classification of the anomalies of the dental system of man is as follows; each of the chapters is devoted to a special topic:

"1. To anomalies of form. These comprise the modifications in the form of the tooth, and either embrace the entire tooth-structure or are confined to the crown or the root.

"2. Anomalies of volume. These are of two orders: augmentation of the normal volume, or *géantisme;* diminution, or *nanisme.*

"3. Anomalies of number. These present three varieties: congenital absence, numerical diminution, and augmentation.

"4. Anomalies of position. These are divided into three groups: simple transposition, heterotopy by migration, and heterotopy by genesis (embryonic).

"5 Anomalies of direction, comprising four classes: retroversion, anteversion, lateral inclination, and axial rotation. The practical interest which is associated with these anomalies relates to the fact that the great majority of them are curable.

"6. Anomalies of eruption. These include the accidental disturbances in the order of eruption, retarded eruption, precocious loss, retarded loss.

"7. Anomalies of nutrition. These comprise all the functional disturbances attacking the nutrition of the tooth during its formative stage. They may include the entire organ, or be confined to one or more of its tissues.

"8. The anomalies of structure. In this group are included all alterations of an anatomical description situated in the different dental tissues; they are either general or limited, according to the nature of their producing cause, and determined by the time and duration of their appearance.

"9. Anomalies of arrangement. This last division includes a certain number of deviations from the normal standard, comprising amalgamation by anomalous division and a variety of troubles incident to deformation of the jaws."

The following table explains in greater detail his subdivision of this classification.

The author assumes that the typical form of the tooth is conoidal. After reverting to the characteristic features of teeth in fishes, he passes in succession to the different classes of animals, making general remarks upon the number of teeth in animals, notably those of the quadrumana. In speaking of the diastema, he remarks that this peculiarity does not imply necessarily the suppression of the canine, since it is found in the greater number of mammals; and that in the upper jaw it is situated between the canines and incisors, and in the lower jaw between the molars and the canines.

Under the head of the anomalies of the dental system, as considered in the human race, he treats of two different phases of the subject:

1. The relations existing between the teeth of primitive and recent man.

2. The variations occurring within the teeth of modern man alone. It has been reported that in the teeth of some fossil men a fifth tubercle has been found

TABLEAU SYNOPTIQUE DES ANOMALIES DU SYSTEME DENTAIRE CHEZ LES MAMMIFERES

- 1° Anomalies de forme
  - Anomalies totales.
  - Anomalies coronaires.
  - Anomalies radiculaires.
- 2° Anomalies de volume
  - Diminution ou nanisme
    - total.
    - partiel.
  - Augmentation ou géantisme
    - total.
    - partiel.
- 3° Anomalies de nombre
  - Absence congénitale.
  - Diminution numérique.
  - Augmentation numérique.
- 4° Anomalies de siége. Hétérotopie
  - Transposition.
  - Hétérotopie par
    - migration folliculaire.
    - introrsion blastodermique.
    - hétéroplastie.
- 5° Anomalies de direction
  - absolues ou totales
    - Prognathisme accidentel.
    - Opisthognatisme accidentel.
  - relatives
    - Antéversion.
    - Rétroversion.
    - Inclinaison latérale.
    - Rotation sur l'axe.
- 6° Anomalies de l'éruption
  - Eruption précoce.
  - Eruption tardive.
  - Chute précoce.
  - Chute tardive.
- 7° Anomalies de nutrition...
  - Atrophie.
  - Hypertrophie ou hypergenèse. *Odontomes.*
    - bulbaires
      - embryoplastiques.
      - fibreux
        - avec ou sans grains phosphatiques.
        - avec ou sans grains dentinaires.
    - odontoplastiques.
      - cémentaires.
      - dentinaires
        - circonscrits.
        - diffus.
      - adamantins
        - Tumeurs hétérotopiques de l'émail.
    - radiculaires
      - cémentaires.
      - dentinaires.
  - Transformation kystique. Kystes folliculaires
    - prédentinaires.
    - odontoplastiques.
    - coronaires.
- 8° Anomalies de structure...
  - totales
    - Défectuosités de la totalité de l'organe
      - accidentelles.
      - diathésiques.
    - Erosion.
    - Colorations anomales des dents.
  - partielles
    - Sillons et défectuosités de l'émail.
    - Vices de structure de l'ivoire.
    - Vices de structure du cément.
- 9° Anomalies de disposition.
  - Anomalies par continuité, réunions anomales.
  - — par disjonction, divisions anomales.
  - — par asymétrie des arcades dentaires
    - Atrésie de l'arcade dentaire.
    - Augmentation des diamètres de l'arcade.
  - Rapports anormaux des arcades dentaires.

upon the upper molars, as well as a fifth root to the inferior wisdom; the root of the inferior canine bifid, while the diastema is present.

M. Broca has observed the difference in the type of the Egyptian people with respect to the shape of the nose. It is found modified in form after the first Ethiopian invasion; but nothing beyond this analogy would seem to imply that any dental variations followed. The author quotes freely from Mr. Mummery as well as from Trousseau with respect to the dental variations in ancient skulls, which go to prove that dental anomaly was as frequent formerly as at the present time.

An interesting section is devoted to the relations existing between dental anomaly and active morbid processes; thus their serving as the exciting causes of cysts, ostitis, fistula, etc. Nor is the subject of anomalies as they occur within dermoid cysts neglected; and that strange phase of development by which teeth and hair are found well developed in localities where no such organs normally appear is thoroughly considered.

Under the head of anomalies of volume are discussed the malformations due to disease, notably those presumably excited by constitutional disease.

Elaborate tables of dental formula are presented, indicating not only the changes in the permanent dentition, but also those of the deciduous, and giving likewise a detailed account of the number of the teeth in mammals.

The plates are handsome lithographs, each containing from one to twenty-seven figures, accompanied with a very full table of description and explanation, and not infrequently figuring apparatus designed to correct malplaced teeth.

The large number of 274 figures in all, illustrate this elaborate study.

In 2000 cases of dental anomalies Magitot examined, he recorded as follows:

Anomaly	of	form ..... 92.
"	"	size .....120.
"	"	position .....193.
"	"	eruption .....154.
"	"	arrangement .....244.
"	"	nutrition .....208.
"	"	structure .....168.
"	"	position .....381.
"	"	number .....440.
		2000.

Nos. 5 and 9 from Plate XI of Magitot's work (Fig. 2) illustrate the devices mentioned by him and are similar to those used by Drs. Richardson and Redman and others. They were used to regulate the upper teeth by means of wooden pegs set in holes throughout the plate. The pegs bear upon the teeth so that they will tend to move in the direction desired. The appliance may be of vulcanite plate as shown in the illustration or skeleton crib form as in Plate XII (Fig. 3, Nos. 4 and 5) taken from Magitot's work, also Fig. 4.

A. H. Thompson. This review of orthodontic literature would hardly be complete if we failed to take into consideration the writing of Thompson. Although these were not purely of an orthodontic nature, Thompson was undoubtedly the foremost dentist in this country who wrote on comparative dental

anatomy. His contribution on this subject appeared in almost all of the dental journals and extended over a period of some thirty odd years. He created an interest in this subject and lived to see it incorporated into our school curriculum. We, as orthodontists, have found it to be the basis of our studies, but only a few have clearly seen the importance of further and deeper investigation

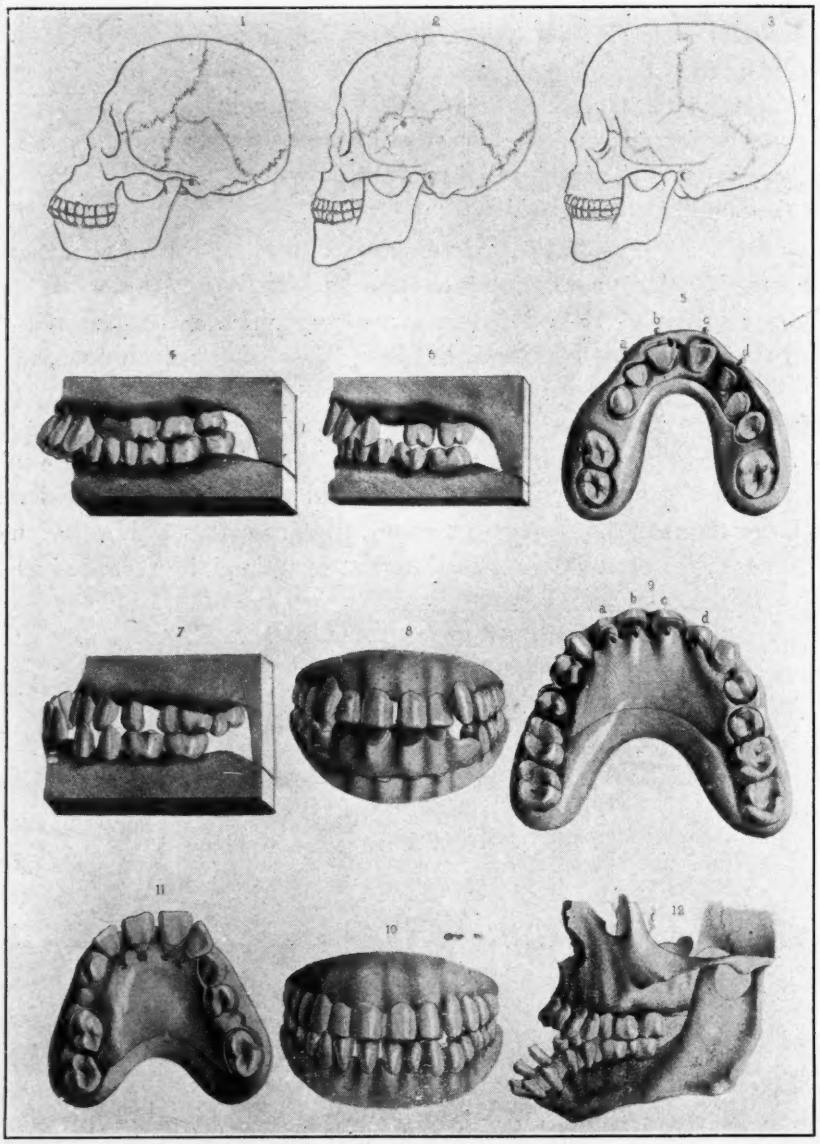

Fig. 2.—Appliances as used by Magitot to correct irregularities of the teeth (Nos. 5, 9, and 11). Vulcanite plate.

along this line of thought. Among a few of his papers we find the following, Canines in Expression, *Cosmos,* 1873; On the Ultimate Suppression of the Teeth in Man, *Cosmos,* 1875; Facial Expression, *Cosmos,* 1889; Origin and Evolution of the Face, *Cosmos,* 1890; The Architecture of the Upper First Molar, *Dental Review,* 1891; The Evolution of the Complex Molar from the Simple Cone,

National Dental Association, 1909; A Study of Comparative Occlusion and Its Bearing Upon Orthodontia, *Cosmos*, 1902.

Under The Dynamics of Dental Occlusion and the Structural Expenditure of Their Maintenance, *Dental Cosmos*, 1876, page 174, he states:

"The force with which the lower mandible is occluded against the superior maxillaries is, in the average mammiferous animal probably without parallel in

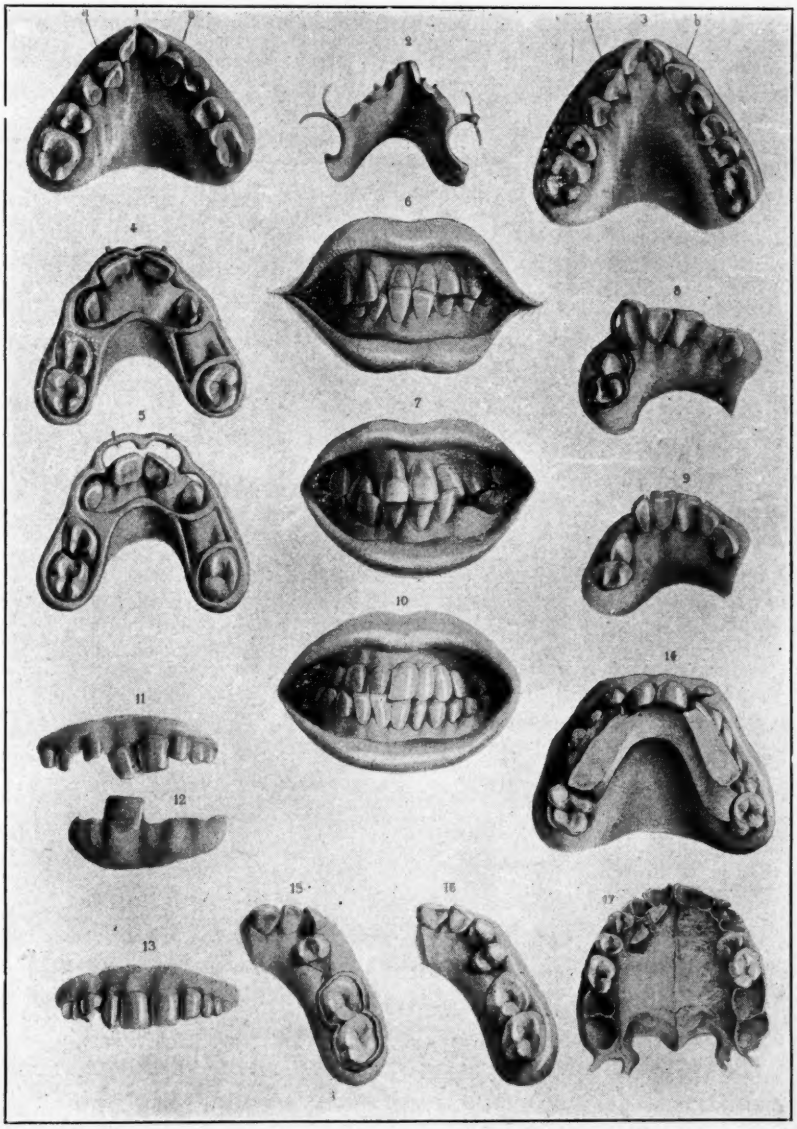

Fig. 3.—Skeleton cribs as devised by Magitot (Nos. 4 and 5). Vulcanite plate (No. 2).

any department of animal mechanics. The principles of construction and motion of the specialized parts devoted to mastication, and the precision and force with which this function is performed in the majority of animals possessing vertical mandibular occlusion, is wonderfully illustrative of the capacity of the animal mechanism for the display of power. The limited amount of tissue of which the apparatus is constructed does not appear capable of the intense manifestations

of force demonstrated. No other single part of the animal structure possesses, dynam for dynam, so much power, even excluding the ratio of size and area; and the capacity exceeds all proportion to the area involved, compared with the average mechanical power of other regions. The arching, the leverage, the static, receiving pillars, and the strong, peculiarly distributed and attached muscular impactors, all quasi-condensed into comparatively limited area about the cephalic alimentary opening, and located on the antero-inferior aspect of the cranium, contain and expend force greatly in excess of other mechanical regions.

"The maximum of area of the masticatory is attained by the herbivorous mammalia, where capacity for motion is more essential than for force direct. Trituration is here an important factor of digestion, especially so in ruminants. The anatomical factors entering into the structural peculiarities of the masticatory region of animals of this class may be enumerated as follows: (1) the construction of the temporomaxillary articulation, allowing lateral, anteroposterior, vertical and oblique movements; (2) the extent of maxillary attenuation developed for the support of extensive masticating area; (3) the suppression of density and diameter of the maxillary bones, thus economizing weight and structure;

Fig. 4.—Another skeleton crib of Magitot (1867).

(4) the predominance of the rotatory over the elevating muscles; and (5) the peculiarity of construction of the masticating armature, the teeth,—i.e., the vertico-parallel arrangement of the dental tissues and the abortion of the crushing teeth.

"Another evidence of the occluding force in man (and one which the dentist and oral surgeon utilize in the important and beneficial operation of the correction of irregularity of the teeth) is the rapidity with which occlusion will cause movement and alteration in position in the alveolus of the teeth. This is observed in almost every denture, in its special manifestations, in causing the natural symmetry of position of the teeth while erupting, and in the too frequent negative evidence of irregularity and malposition owing to premature or retarded eruption. This is accomplished by the occlusion of inclining surfaces, which is so powerful for movement.

"Another indication of the force is the development of the bones and muscles that support the teeth. The growth of the maxillaries exhibits dependence on the occlusion of the teeth for perfect and symmetrical production. Being at birth mere shells containing the active, laboring tooth-forming pulps and growing crowns, as the teeth erupt and mastication comes upon them the bone solidifies

and braces up the forming and formed roots to support the force. When the second denture comes into place the arch enlarges posteriorly, strengthens its substance, develops static force, and its arches and pillars of resistance but become more firm and dense with use. Negative evidence is again furnished by mal- and asymmetrical development, due to irregular eruption of the teeth, and the growth of bone prevented by the loss of the stimulus of occlusion. This force exercises a potent and wonderful influence in the acceleration of the growth of the bones and muscles, and the symmetrical moulding of the face in normal development.

The muscular system is dependent upon the irritation of use for perfect development, and the rising teeth require employment to effect successful eruption. This need is so strongly felt, that the desire to masticate in a child amounts to a passion, a ravenous desire, in reply to an imperative demand from nature. Not only is this true previous to eruption of the teeth, when it is mainly membranous, but subsequently the desire is so strong that its indulgence produces a decided pleasure to the parts. Occlusion seems a necessity to perfect development, for

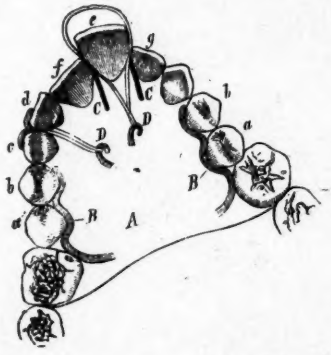

Fig. 5.—Apparatus of vulcanite rubber, as used by Wilpart.

growth depends largely upon the irritation of use, and the desire to indicate a growing insufficiency of employment in the species.

"With the presence of the teeth and their active use, the integrity of the jaws and muscles may be said to be maintained. As these are gradually lost as life passes on, the alveolus rapidly and the maxillaries and muscles slowly atrophy and become reduced. Slight irregularity, visible asymmetry, results, and the final total loss of the denture produces the well-known shrunken face of edentulous persons, especially when aged. This sunken appearance of the masticatory region is not due alone to the loss of the teeth. Suspension of the irritation of use to the parts brings a marked atrophy of bones and muscles, from withdrawal of the nutritive supply and consequent reduction. Asymmetry is frequently observable in persons who acquire the habit of asymmetrical mastication when the teeth are yet present, owing to disease of the latter, or some other lesion, upon one side. The substitution of artificial dentures will not restore atrophied muscles and plumpness of visage, for the reason that the required force can not be sustained, and is not attempted. Valuable lessons might be drawn from this fact in artistic prosthesis. In age, disease usually renders the teeth, when remaining, unable to bear forcible occlusion, and in this way disuse accelerates the ordinary atrophy of senility."

Wilpart, *Vierteljahrsschrift f. Zahnheilkunde,* p. 152, 1877. Wilpart used an apparatus made of vulcanite rubber with small hooks of gold attached to same. To these were fastened elastic rings, which were put on the teeth to be moved. This appliance affords nothing new and is seen in Fig. 5.

Alfred Coleman, before the Odontological Society, Great Britain, 1877, in a paper entitled *"On Certain Points in the Treatment of Irregularities: Extraction Vice—Expansion of the Dental Arch,"* explained the Coffin Plate and its advantages. There was nothing new recorded as to etiology, etc., however, this is the first time we find the Coffin Plate illustrated. George W. Fields, in discussing this subject, says, "For expanding the arch he used the plan spoken of by Mr. Coleman, that invented by Dr. Coffin. It was important to ascertain in

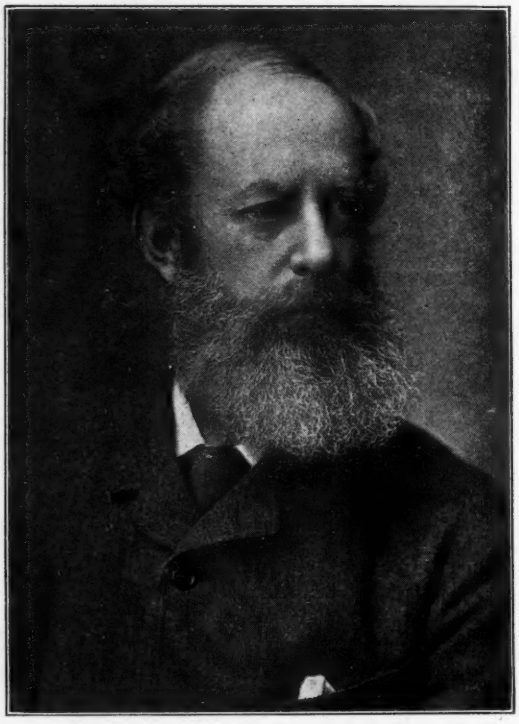

Fig. 6.—Alfred Coleman (1877).

each case the proper position for the spring, so as to get the pressure on the proper teeth. He had known it to cause separation of the median suture in very young children, proving that the spring had some power."

W. E. Hyde, in the *Dental Cosmos,* page 406, 1878, described the following new rotating appliance:

"The 'dipper' wrench, made by fitting the tooth with platinum foil, and afterwards covering with solder, and the 'box' wrench of Dr. Farrar, while both excellent, are, nevertheless, somewhat expensive, and sometimes difficult to apply, while this device can be made in five minutes, and at a nominal expense, and can be adjusted to any tooth. It may be old to others, but in my office it is a two-weeks infant, yet it promises great things.

"Take a piece of fine gold, silver, or platinum wire, five inches long, and bend

it into a double loop, as shown in Fig. 7, 1. Put the point of an excavator through at (*a*) and, taking hold at (*b*) with thumb and finger, twist the four wires into a cable (*c*) (Fig. 7, 2) the excavator making the loop at (*d*). Now cut open the small loop (*e*), and bend the ends back on the long ends as in Fig. 7, 3, and place a bit of solder at (*f*), holding it in the blaze until the short ends are soldered down so as to make a firm, rigid base for the lever (*c*). Pass the long ends around the tooth to be rotated, and bring them back to the lingual surface of the tooth. Fasten securely by twisting together. You have a wrench which can be bent up close to the roof of the mouth, or any desired angle, and will remain perfectly firm. Apply the rubber as usual."

Geo. S. Allan, before a meeting of the New York Odontological Society, November, 1878; *Dental Cosmos,* page 92, 1879, presented a paper entitled, *Protrusion of Lower Jaw and Treatment.* "In April last a little girl brought to me for dental treatment only, but noticing that the lower jaw presented a very marked protrusion, I advised that it should be immediately treated with a view to the removal of what was a positive deformity, and was asked to undertake

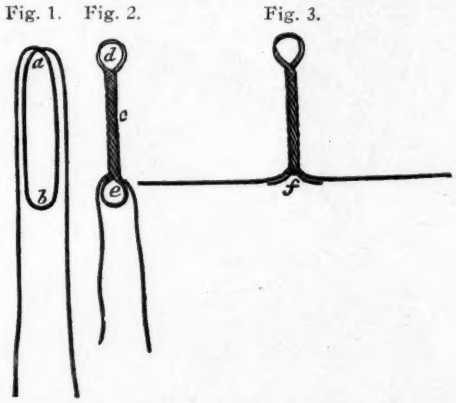

Fig. 7.—Rotating appliance described by W. E. Hyde (1878).

the treatment. The deformity was entirely in the under jaw, which was, as usual in such cases, of abnormal width, and projected so that the lower arch extended outside the upper throughout its whole circuit. Usually, in such cases, I direct delay, before beginning to operate, until the permanent teeth are all in place. But, after consideration, I adopted for this case a different plan. As the irregularity appertained to the jaw itself and not to the arrangement of the teeth, I decided to operate upon the jaw alone, and to bring about a correct articulation of the teeth as a sequence. My first plan was to construct two dental splints or plates of rubber one each for the upper and lower jaws, having a protuberance on each in the nature of an inclined plane, which would act, during closure of the jaws, to force the lower one backward. But I did not persevere in this direction, for I soon found that it would be of little use. Then, directing the child to continue wearing the upper plate, I set to work to make an apparatus that would pull the lower jaw back, keeping the upper splint alone in place. As you will see from the photograph (Fig. 8) taken at the time she was wearing this apparatus, it consists of two parts. For the lower part I made a brass plate to fit the chin, having arms with hooked ends reaching to a point just below the point of the chin. These arms were arranged in such a way that the distance

between them could be altered at will by simply pressing them apart or together. The upper part consisted of a simple network going over the head and having two hooks on each side, one hook being above, and the other below the ear. When this apparatus was completed and in use, there were four ligatures of ordinary elastic rubber, pulling in such a way as to force the lower jaw almost directly backward. I relied upon the elastics attached to the lower arms to do the main work. The upper elastics were simply used to keep the mouth closed so that the lower elastics would not pull it open, the upper elastics being made just strong enough so that the child, in the natural operations of eating and talking, would not have to strain the muscles of the mouth to keep the jaw open. The work proceeded very rapidly, much more so than I had expected, so that at the end of two months, instead of six (as I had told the mother of the child it would take) the irregularity was almost entirely cured. At about the end

Fig. 8.—Head and chin cap devised by Geo. S. Allan (1878).

of the first month there came a stop, and for two weeks I could not get the jaw to move one particle, which puzzled me very much. The mother said the child wore the apparatus regularly, day and night, and she knew of no reason why the work should not go on. I had the child brought down to the office in the morning and kept her there all day watching her, and I found that when she was busy at reading or play, she would push the network on the head back so that the elastics did not pull. Thus that puzzle was solved. I then directed the mother to watch her carefully, and keep the band of the network well on the forehead, and also more carefully directed the young Miss herself and warned her that she would lose all that had been done if she was not more careful in the future. After this the work went on steadily to completion. In a little over two months the under teeth were completely inside of the upper.

"I was puzzled at first to understand how I had obtained so great an amount of recession in the lower jaw, but on carefully examining the skull and position

of the parts at the child's age, the proper solution of the problem soon presented itself. The jaw at that period of life is completely developed and hardened. When a child is one year old the union between the two lateral halves of the jaw takes place, and at eight years the jaw is solid. Consequently any efforts that may be made will not affect the jaw-bone itself. The only way in which the change can be made is by pushing back the condyles of the jaw into the glenoid cavity. Allow me just here to show you the skull of a child about five years of age. The articulation between the glenoid cavity and the condyle is peculiar, in that there is a double synovial membrane between which there is a cartilaginous bursa. This cartilage gives way and absorption takes place at the posterior side of the condyles, with filling in of the anterior, so that the whole operation consists in pushing the condyles of the lower jaw into the glenoid cavity of the temporal bone. Until the articulation has again receded by the natural protrusion of the teeth, I suppose the child will have to wear the apparatus more or less. I had it taken off to bring here this evening. I should certainly in any similar case presented hereafter, even at twelve or thirteen years of age, before attempting any other procedure, try this first and thoroughly."

Thomas Wardle, under *Protrusion of the Lower Jaw, (Dental Cosmos,*

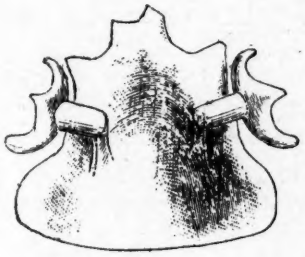

Fig. 9.—Gold plate as used by Thomas Wardle (1879).

1879, page 371) for a young lady of nineteen, prescribes the following method of treatment:

"The arch of the upper teeth was much less than that of the lower, the outer cusps of all the latter were outside of the former, necessitating an expansion of the arch of the upper jaw as well as a reduction of the protrusion. To accomplish the first object a self-acting plate was designed, illustrated in Fig. 9. The plate which was of gold, was made to fit the arch of the mouth as for an upper denture. To this were soldered two posts of platinized gold, set opposite the palatal faces of the bicuspid teeth and about three-eighths of an inch distant from them, their lower ends being on a line with the cusps of the teeth to be acted upon. At right angles with these were soldered oval tubes, closed at their palatal ends by the posts to which they were soldered. To these oval tubes were fitted sliding bars having semicircular clasp-shaped cross pieces neatly fitted to the bicuspid teeth. In the application of this plate to the mouth, small pieces of soft rubber were inserted into the tubes and increased from time to time as required, which maintained a gentle constant pressure, resulting in a short time in the desired expansion of the jaw and a lowering or flattening of the palatal arch about three-eighths of an inch. This little appliance was worn with entire comfort, and the patient soon learned to adjust it herself.

"Previous to any attempt to overcome the protrusion of the lower jaw it was necessary to extract the last tooth on one side of the upper jaw, because of its antagonistic relation to the lower teeth. A cap was made of strong twilled silk, lined with unbleached muslin, covering the head completely, the sides coming a little below the upper part of the ears, and was cut out to fit around them. A chin piece was made of morocco leather, which was lined and fitted to the chin, covering the space between the bicuspid teeth. To the ends of this chin piece were attached straps for attachment to the cap behind the ears. Two other straps were attached to the upper edge of the chin piece, arranged to join the head cap about the center of the attachment of the temporal muscles. The four straps were thus attached to the head cap, divided in their centers, and provided with buckles so arranged as to prevent their coming in contact with the patient's face. The whole apparatus was so simple in its construction that the patient could remove or adjust it at pleasure."

(*To be continued.*)

DEPARTMENT OF
DENTAL AND ORAL RADIOGRAPHY

ROENTGENOGRAMS OF PULPLESS TEETH*

DR. HAROLD O. HANSEN, D.D.S., CHICAGO, ILL.

THERE has been a great deal of criticism recently in dental literature regarding the wholesale extraction of teeth by dentists who have had no special training in the interpretation of dental radiographs and also due to the hasty advice of physicians who hoped the patient would improve as a result of the extractions.

We are daily confronted with patients who present themselves for treatment, and our primary object with every one is to remove infection whether due to unfilled roots or pyorrhea. It is imperative that the patient have a well made set of radiographs of the entire mouth and if any area is doubtful another radiograph should be made at a different angle and it is often surprising to see how differently a condition will appear as the x-ray at best is but a shadowgraph and is never a clear photographic expression of the pathologic condition. Distortions due to varying density of structures and differences due to angles of focus are often responsible for wrong impressions and frequently the x-ray will permit infected areas to pass unnoticed. It is in these unrecognized foci of infection that real danger lies, especially if after the x-ray has shown no appreciable pathological change and the patient is assured that the x-ray shows nothing. When as a matter of fact there may be the foci of infection there, that may be the cause of considerable systemic trouble. So it behooves the roentgen operator to employ every precaution in obtaining radiographs possessing rich detail so that a definite scientific diagnosis may be made.

Too often the size of the area above a pulpless tooth is taken as an indication of the amount of harm that might result which is entirely wrong as the most virulent infections are usually found in the smaller areas. Again an area of in-

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creased transparency instead of meaning that it contains an active infection may contain a granuloma where the old abscessed condition has undergone the process of repair or may still contain infectious matter ready to spring into full activity upon the slightest irritation.

Schuhmann has recently stated that other sinus shadows over teeth are due to the fact that in the process of devitalizing and treating teeth many times drugs are employed which act as strong escharotics and the result may be a coagulation of lymphoid matter over the root end which will appear as a darkened shadow over the apex of the tooth. So exercising all the care and skill an individual can in the passing of judgment on dental radiographs he will still make a few mistakes but when in doubt always let the old slogan "safety first" be your guide and extract. I also feel that no one is justified in passing judgment on a set of radiographs without seeing ahe patient or at least having a full history of the case and more definite results will be obtained if radiographs are studied while examining the mouth, also having thorough knowledge of the patient's general systemic condition.

No matter how well a root may be treated and filled there is still an element of doubt as to whether or not there may be some hidden infection there and Rosenow makes the statement that every devitalized tooth has an area of lowered resistance about the root end and should be considered unsafe.

Beginning or inflammatory changes of bone infection are not discernible in the radiograph as it does not at once produce gross bony liquefaction. After several days or weeks there is sufficient decalcification for recognition: so when an area is found over an apex it is hard to determine the length of time infection may have been present.

In the face of these facts in order to insure safety for our patients it is necessary to continue with extractions but instead of being condemned hastily as in the past we now feel inclined to weigh carefully the radiographic and clinical findings and take into consideration the personal equation and when we conscientiously exercise these precautions no unnecessary extractions will be done as the medical profession are now leaving these serious questions to the dentist who has an understanding of roentgenographic pathology.

It is not my purpose in this short paper to attempt to discuss all that would come within the scope of this field but to limit myself to these three phases, namely:

1. Indications for the extraction of teeth. 2. Indications for treatment. 3. Indications for keeping under observation.

In the first classification I will mention a few conditions in which we find pulpless teeth that we can with impunity remove. All pulpless teeth which are not necessary for cosmetic reasons and of no use in mastication should be extracted. In this class will be mostly third molars around which will also be found pockets harboring bacteria due to the fact that there is usually not enough space to completely erupt and the tissue overlies the enamel surface but can not attach. All teeth which show a definite area of infection on a patient who is beginning to show evidence of the absorption of toxins should be relieved of these infected areas as it is nothing short of criminal to allow them to remain and as a consequence have a heart lesion or an impaired joint.

All pulpless teeth over which there is a cyst, removal is usually necessary and also the entire cystic membrane to prevent too great a loss of bone due to the continuous pressure of the cyst wall on adjacent structure and often becoming secondarily infected, causing a great deal of trouble.

Teeth which have been treated and the walls of the canals perforated, the usual result being an alveolar abscess, should be removed.

In the process of treating teeth one often encounters a condition where it is impossible to gain access to the infected area through the root canal, due perhaps to the fact that a phalanx of cement has been forced into the canals which can not be removed, also broken broaches are often met with high in the root which can not be taken out, so the tooth should be extracted.

Any tooth where the pulp dies before the roots have attained their full growth, leaving a wide open root end, invariably are seriously infected and should be taken out.

Impacted teeth under most conditions should be extracted but I will not go into this subject as it is too lengthy for consideration here.

Teeth infected from pyorrhea where the radiograph shows the bone structure gone to any extent should be taken out but this is a subject in itself and worthy of a paper on that alone.

Under the heading of teeth to be retreated, I will mention just a few conditions where this can be safely done.

Moorehead says that less than ten per cent of dentists are able to do reliable root canal work due to lack of technique and proper training in so highly a specialized operation requiring a knowledge of medicine plus aseptic surroundings and a great perseverance, requirements which are possessed by only a few.

Teeth which have only an indefinite area about the root end where the canals can be opened may be treated and filled but the x-ray should be used to show the work properly done and another radiograph taken about a year later to see that no further trouble has developed. In patients who are in the best of health one may attempt treatment in teeth showing large areas but often in these conditions the root ends are roughened and to insure freedom from reinfection a root resection should be performed which is usually successful if well done.

In the classification of pulpless teeth to be kept under observation I have many in mind where the root end is very small and the canals may not be properly filled and where there is no evidence of infection over the apex, and the tooth perfectly comfortable. If these teeth are opened and treated and the root end enlarged it is subject both to hemolytic infections, and infection introduced from without, and better left untouched. These teeth should however be radiographed a year or so later and if still in the same apparently safe condition will beyond doubt remain so indefinitely. In this class the upper bicuspids are the most frequent.

In the darkness and doubt of infections of pulpless teeth and the demand for "more light" we find our only solution in the prevention of these conditions is to avoid the initial introduction of caries in tooth structure and this can be done by strict prophylaxis. Dentistry in the past fifty years has made wonderful strides and the men responsible for this progress are worthy of highest praise. In the past, however, nearly every effort has been to repair lost tooth structure

with but little thought being given to prevention. In the new era upon which we are entering, when prophylaxis will be practised and preached, we will have mouths where every tooth is highly polished instead of broken down and infected. At least 90 per cent of decay and 95 per cent or even more of the dead pulps will be prevented and the patient have teeth beautiful to look at, as well as representing the maximum in masticating efficiency, and comfort, with absolute freedom from pyorrhea and gingivitis. This Utopian period in dentistry is bound to come as it is the very essence of common sense, but will come much sooner with the earnest cooperation of the medical profession.

A DISCUSSION OF WHAT HAPPENS IN A ROENTGEN TUBE*

B. H. Orndoff, M.D., Chicago, Ill.
President of the Western Roentgen Society

IN order to form a conception of what happens within a roentgen tube, one must understand something of the nature of matter and especially those elements of matter entering into the construction of a roentgen tube, as well as electricity.

In this paper, I propose to discuss briefly and as far as possible separately:

1. The Anode or Anti-Cathode
2. The Cathode
3. The Electrical Discharge
4. The Cathode Ray
5. The Roentgen Ray

My discussion of the roentgen ray will be very brief in this paper and will be concerned only with what seems to be the most useful theory of its production at the anode.

The kind of tube upon which I wish to base my remarks principally is the hot cathode or coolidge tube. In this connection, I wish to say that in my judgment, we as roentgenologists owe our greatest debt of gratitude to Dr. W. D. Coolidge, excepting only W. C. Roentgen, the discoverer of the rays themselves.

The Coolidge tube as it stands to-day marks the greatest step in advance in the science of roentgenology since Roentgen discovered the rays.

Aided by such co-workers as Hull, Davey, Moore and others, Dr. Coolidge through the experimental laboratories of the General Electric Company continues to be our most potent and productive source of scientific achievement for roentgenology.

The coolidge tube is superior in almost every respect to any other form of roentgen tube.

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THE ANODE (ANTI-CATHODE, TARGET)

Several points are to be considered in discussing the anode. Because of its high atomic weight tungsten has been almost universally adopted for this purpose It has an atomic weight of 184.0.

The atom of tungsten at ordinary temperature shows very little tendency to liberate negative electrons. It is this property which makes the hot cathode type of tube capable of carrying an electrical discharge in one direction only.

Tungsten is also suitable anode material because of its high melting point, which is about 3400° C. in the atmosphere.

Tungsten also possesses high thermal conductivity. Comparing with platinum as 0.35 to 0.17. This property accounts for the rapid distribution of the heat generated at the focal spots throughout the mass of material in the anode and thereby permits a small focal point so essential in clinical roentgenology, described so nicely by Kreugler.

Tungsten also possesses a high radiation value and compared with platinum is as 91 to 100.

Tungsten has a low vapor pressure at very high temperature. It shows evidence of volatilization at about 1800° C. Melts at 3400° C. and boils at 3700° C.

CATHODE

A study of the cathode is closely interwoven with the study of the electron and the electrical theory of the constitution of matter. This theory is the most serviceable basis for our best explanation of the origin of roentgen rays and the physical reasons for the properties of radioactive substance, such as uranium and radium.

Until the coolidge tube was introduced, we were concerned with various physical phenomena within the roentgen tube. This has now been entirely eliminated. The hot cathode type of tube as introduced by Dr. Coolidge in 1912 depends entirely for its operation upon the thermionic emission from the cathode.

In the old type of tubes various metals were used in the cathode. The most suitable kind of cathode material was generally conceived to be aluminum. It was found to be especially adapted for this use because of its atomic construction. Its atoms possess vast zones of loosely combined electrons as compared with platinum and tungsten. This fact aided greatly in maintaining its position in the electrical discharge as the cathode pole.

Aluminum delivers electrons more freely as the temperature rises. The heat generated at the cathode during an electrical discharge in a vacuum tube is roughly proportional to the amperage of the current used in the discharge. It is evident then that aluminum automatically adjusts itself in liberating electrons to meet the demand made upon it at the cathode pole. It will be readily observed that if the amperage is sufficient, the heat generated at the cathode will be high enough to melt the aluminum, and the molten portions would be found to fly away from the cathode and become flattened out against the glass on the opposite side of the bulb.

If the cathode and anode were constructed of the same materials or metals they would also present the same capacity for liberating electrons and would be equally balanced in their tendency to allow the current to pass in both directions.

Aluminum was also found suitable because its volatilizing power was high, in fact almost as high as the melting point. It also has the property of liberating hydrogen when heated to a degree sufficiently high to force it to give up its gases.

Hydrogen has been found to cause very little if any damaging phenomena in the tube unless liberated from the metals in considerable quantities.

Inasmuch as it is my purpose to discuss almost entirely those phenomena in a roentgen tube of the hot cathode type, I will reserve further discussion of the cathode as presented in a coolidge tube until later in this paper.

ELECTRICAL DISCHARGE

Any complete description of an electrical discharge in a vacuum tube must involve a consideration of the production of the current and of what it consists.

In this connection, I would like to present a few brief statements. Most of us remember the study of two kinds of electricity—*positive and negative.* Bodies with similar electrical charge repel one another. Bodies with unlike, that is, positive and negative charges, attract one another. (Fig. 1.)

In the analysis of matter, we may recall that bodies are composed of mole-

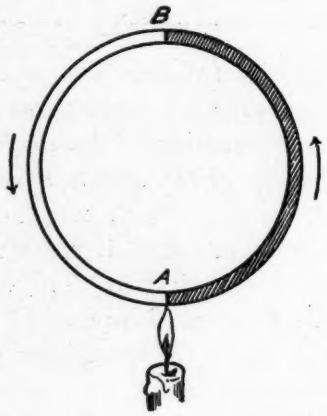

Fig. 1.—A THERMO-ELECTRIC CIRCUIT. This is a symbolic drawing. The circle as a whole represents the complete electrical circuit, the left half being composed of a metal which emits electrons freely and the right half of one which parts with its electrons less easily. If the junctions *A* and *B* are both at the same temperature no current will flow, since the tendency towards a clockwise current which exists at *B* is exactly balanced by the opposite tendency existing at *A*. However, when the junction *A* is heated these tendencies are no longer exactly in equilibrium and electrons move around the circuit in the direction of the arrows. It is not necessary that the circuit should be made up of equal masses of only two different metals. It may be broken at any point and long wires of any sort of conducting substance introduced without altering its general principle. (From Comstock and Troland.)

cules. These molecules are of almost every conceivable shape. They depend for their properties upon their number, nature and geometrical arrangement of their atoms. Such enormous numbers of variations are hereby possible as to permit the formation of a vast number of different substances. For example, there are now known several hundred thousand substances in which the molecules are composed for a part at least of carbon, and that the other elements in these molecules are but three in number—hydrogen, oxygen and nitrogen. Undoubtedly many other molecules than those now known with carbon are in existence and await further work for their discovery.

At the present time our knowledge covers about one hundred distinctly different atoms. If one substances is found to attract another substance, it indi-

cates that the atoms composing their molecules have unlike electrical charges.

The atoms depend for their electrical charge upon their electrons. The atom consists of a nucleus and electrons.

The nucleus possesses always and under all circumstances a definite positive charge of electricity. Very little more is known concerning the nucleus of the atom.

Surrounding the nucleus are vast numbers of negatively charged particles called *electrons.* These electrons may be thought of as surrounding the nucleus in different zones or fields. Certain zones are held very firmly by the nucleus. To remove electrons from these zones would greatly alter or cause destruction of the atom itself. Other zones of electrons are held by the nucleus more feebly and it is in these zones that electrons may be detached and removed or added to the atom without greatly altering the general nature of that particular atom.

The size of the electron is very small as compared with the size of the atom. As an illustration, it has been stated that if an atom were thought of with a diameter of 100 yards, its electrons would be approximately the size of a pinhead. (Fig. 2.)

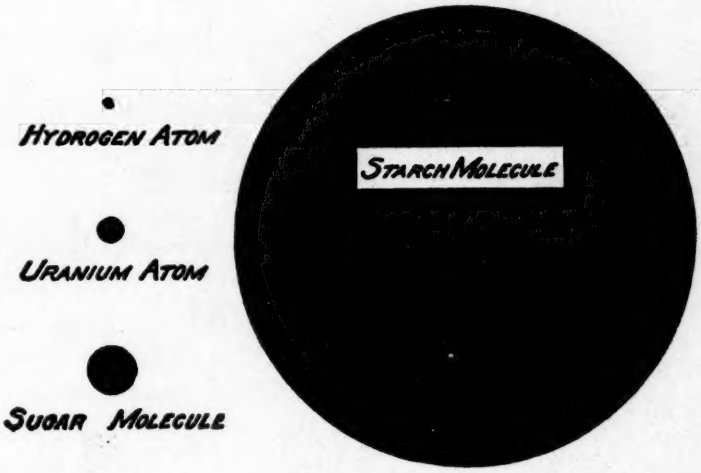

Fig. 2.—THE RELATIVE SIZES OF ATOMS AND MOLECULES. This diagram is intended to give an idea of the relative magnitudes of atoms and molecules. However, the drawings are only symbolic, as the dimensions have been calculated on the assumption that the molecules are spherical, which cannot be strictly true. It will be noticed that the smallest atom (that of hydrogen) differs only slightly in size from the largest atom (that of uranium). The starch molecule is probably one of the largest which exists and it will be seen that, according to the diagram, it is very much larger than the largest atom or than the molecule of sugar. The relative weights of the particles represented are as follows: Hydrogen, 1; Uranium, 239; Sugar, 366; and Starch, not accurately known but probably about 25,000. A molecule of ordinary alcohol weighing 46, would be slightly larger than the uranium atom. (From Comstock and Troland.)

If the nucleus with its positive charge of electricity has sufficient electrons, the atom becomes electrically neutral. If this number be decreased, it then possesses a positive charge. If the electrons were increased, it becomes negatively charged. (Fig. 3.)

Electricity exists in the form of the power of electrons seeking an unsatisfied nucleus. An electrical current means a movement of electrons towards a positively charged center. As stated before, only certain electrons or perhaps zones of electrons in the atom are capable of leaving the nucleus without alteration or destruction of the atom.

The attraction which is manifested by some classes of atoms for an electron is much greater than others. Metals as a class show very feebly atomic attrac-

tion for electrons. As a class of substances it will be readily observed that metals are excellent media through which electrons may be transported or in other words metals are good conductors of electrons or electricity.

If a current is passed through a metal, say a copper wire, it indicates that electrons were introduced at one end of that wire and delivered at the other end of the wire.

The speed which electrons assume in the conduction of a current through metal must not be confused with what has been termed the *speed of electricity*. The actual movement of the electron in metallic conduction is in fact infinitesimal to the speed of electricity. In this case electrons move at the most but a few centimeters per minute. The speed of electricity is very close that of light (186,300 M. per second). It consists of an impulse to move passed from one electron to another. This might be illustrated by placing two billiard balls upon a table

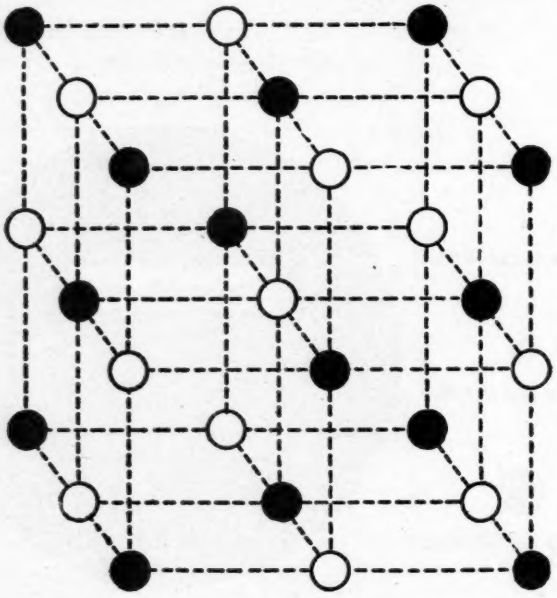

Fig. 3.—STRUCTURAL PLAN OF A SIMPLE CRYSTAL. This drawing represents the structure of a crystal of potassium chloride, a substance similar to ordinary salt, as deduced from its action upon x-rays. The dark spheres represent chlorine atoms, the light ones atoms of potassium. It will be seen that the unit of structure of the crystal is the individual atom, since all of the atoms are equidistant from their immediate neighbors. For the sake of clearness, the spaces between the atoms have been exaggerated, as compared with their diameters. (From Comstock and Troland.)

a definite distance apart and permit the ball struck to cross the distance to the second ball and deliver its message to move. If the distance between these two balls were composed of a direct line of balls, the impulse to the last ball to move would occur in a very short space of time after the first ball received the impact. In the case of an ocean cable, an electron might be years traveling from New York to London while under proper conditions an electron at the New York end set in motion is noted in the electrons at the London end of the cable but a small fraction of a second later.

While the illustration answers very nicely for the passing of a current through a metallic conductor, the space between the two poles in a vacuum tube is very different.

As an electrical current is discharged into a vacuum tube, there must be an

actual movement of electrons since the distance between the two poles is not bridged by atoms through whose electrons the electrical impulse may be passed.

It is evident then that an electrical discharge into a tube with rarefied atmosphere or any form of roentgen tube causes for the main part a liberation of particles with similar electrical negative charges.

In the hot cathode or coolidge type of tube there are few if any positive ions liberated from the anode. There is no appreciable generation of heat at the cathode except that due to the filament current. The vacuum is so nearly complete and the metals so nearly gas free that under all temperature this tube may attain in ordinary work, there are no phenomena of interest other than that arising with the thermionic discharge currents.

The walls of the coolidge tube possess a negative charge differing in this respect from other types of tubes.

The speed which the electrons assume in passing from the cathode to the anode determines the wave length of the roentgen ray thereby generated. The more rapidly the electron is moving when making a contact with the atoms of the anode, the shorter the wave length thereby generated. The speed which the electrons assume in the coolidge tube depends as in all other tubes upon the potential difference of the two poles at the time of the discharge.

Each electron as it passes on its course from the cathode to the anode represents a particle with a definite negative charge of electricity and possesses its radiating line of electrical force.

In the coolidge tube the discharge is purely electronic and of thermic origin. The number or rapidity of their discharge depends entirely upon the degree of heat at the cathode. They are liberated from the heated spiral of tungsten in the cathode. They are concentrated upon the anode in a focal spot.

The number of electrons leaving the cathode determines the amount of milliamperage of current passing through the tube. Again it may be noted that in the coolidge tube electrons are not interrupted on their way from the cathode to the anode by the presence of ions or atoms from gases within the tube.

CATHODE RAYS

The cathode rays represent the electrons delivered into a vacuum tube from the negative pole of a suitable electrical current. These electrons have the cathode in abeyance of the forces of attraction to the anode.

The weight or mass of these electrons is said to be about 1-1800 part of the smallest known atom—that of hydrogen.

Their speed varies greatly, but generally it may be said to be about one-tenth that of light.

Their shape is said to be spherical when traveling at low speed, but that they become oval or flattened when traveling at a speed approaching that of light.

It has been shown that they leave the cathode at right angles to the surface of the cathode pole. They travel in straight lines until they are interrupted in their course.

They are capable of passing through solid substance, even through atoms themselves.

Cathode rays can be bent out of their course by the action of a magnet. They also respond to the action of an electrical field in much the same manner as that of a magnet, except that they are deflected at right angles to the direction they assume when passing under the influence of a magnet.

While cathode rays are by far the most conspicuous and the most important rays present in a tube, there are other rays which deserve mentioning.

In tubes containing rarefied gases, there have been described positive rays or canal rays. These rays travel in the reverse direction to the cathode rays. They represent ions which in the course of events have become detached from the anode and pass through the cathode stream or rays to the cathode.

An ion is an atom from which certain of its electrons have been removed leaving it with a positive electrical charge. It has been shown that a small portion of the positive rays are deflected in their course in much the same manner as cathode rays by the action of a magnet or an electrical field. The lines of their deflection however are in opposite directions to the lines of deflection noted with the electrons under the same influence. This fact corroborates the supposition that they have a positive charge. It has also been shown that they are much greater in masses or inertia. They probably reach the size of a hydrogen atom.

Cathode and positive rays can be demonstrated very nicely by placing a bead of lithium chloride in the tube when it will show a blue fluorescence by the cathode rays and a red fluorescence on the side facing the anode from the positive rays.

Positive rays have ionizing, fluorescing and photographic action.

It is evident from what has been said that in old or aluminum cathode type tubes, there are no cathode rays streaming over to the anode until the atoms in the anode have been deprived of certain electrons to the positive side of the dynamo, which generates the current. Then, from the negative side of the dynamo the cathode will become overfilled with negatively charged particles. At this instant positive ions are liberated from the anode seeking negative particles. They will, of course, bombard the cathode. It is this bombardment which accounts for the heat generated at the aluminum cathode. The heat generated at the cathode is about one-fourth that generated at the anode in this type of tube.

The whole process of liberating electrons from the cathode is dependent upon the positive ion bombardment and the subsequent heat generation. It is these positive ions which do not reach the cathode but are attracted to the glass surface of the tube and deliver a positive electrical charge to the wall of the tube when in action.

ROENTGEN RAYS

As the electron leaves the cathode en route to the anode, it represents a moving body possessing a definite electrical charge. Any body possessing an electrical charge is surrounded by a zone of electrical force radiating from the body in all directions.

If the charged particle or body is moved from one position to another, it carries its lines of electrical force with it. As it moves it must take a direction parallel with certain lines while at a greater or lesser angle to all other lines, inasmuch as the lines extend in all directions from the body.

After a charged body is set in motion and continues to move at a constant speed in a straight line, it becomes surrounded by the same zone or field of force lines with the same properties as when the body is at rest, and not influenced by or exerting influence upon any other body.

If this charged body is interrupted suddenly in its course, the lines which radiate from it continue to move in the same direction until the effect of the interruption of the central charged impulse reaches them. This impulse or news of the interruption moves along these lines of electrical force with the velocity of light. This impulse or news of the interruption to the central charged particle has been described as kinks in the electrical force lines. These waves represent electrical waves or light waves.

It is the speed with which the kinks or waves in the electrical force lines follow one another that gives quality to light. The slow wave representing hertzian or heat waves. The shorter waves may represent visible light, ultra violet light, roentgen rays or finally the rays of radioactive substances.

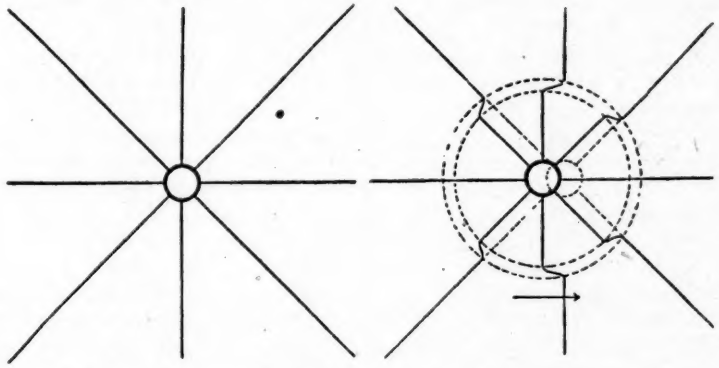

Fig. 4.—TO SHOW HOW RADIATION IS PRODUCED BY STOPPING THE MOTION OF AN ELECTRICAL PARTICLE. The diagram at the left represents a charge of electricity with its radiating lines of forces. We will suppose this charge with its lines to be moving uniformly in the direction indicated by the arrow in the diagram at the right. When the charge is suddenly brought to rest the "lines" have a tendency to continue in motion, and do so until, so to speak, the news of the stopping of the charge has reached them. This "news" travels outwards from the charge with the velocity of light, along with the "kinks" in the force-lines which result from the discrepancy between the actual and the "expected" position of the charge. These kinks contain electromagnetic energy and constitute light and other forms of electromagnetic radiation. Such radiation is produced whenever any change whatsoever occurs in the state of uniform motion of an electrical charge.

All light whether it be the sun or the heat or hertzian waves travels at the same speed, but it possesses different wave lengths. Hertz waves of wireless telegraphy are over a mile in length, while the violet ray (the shortest visible ray), has wave lengths of about one ten-thousandth of one inch in length.

Roentgen rays depend for their wave length upon the speed at which the electron is traveling when it makes contact with the anode. It is the atoms of the anode which furnish the interruption to the electron, causing the kinks in their lines of electrical force and thereby generating roentgen light.

Where the potential difference at the two terminals within a tube is great, or as we may say the voltage is high, the electrons assume a very high speed in traveling to the anode. The interruption produces therefore a shorter wave in its force lines. On the other hand, low potential variation means low voltage and longer waves. Rays with short wave length possess great penetrating power, and as the wave becomes longer the penetrating power is decreased.

The wave loses its effectiveness as it passes on its course from the anode. This loss is estimated as varying inversely as to the square of the distance.

Not all rays emanating from the anode are of similar wave lengths. Certain waves are generated as the electron reaches the first atoms of the anode. The electron reaches the first atoms of the anode. The electron probably passes through the first zones of electrons of the atoms of the anode, even through the atom to the deeper layers of atoms. Each point where its speed and course are interfered with represents a ray of different wave lengths. Each wave after the first interruption will be of longer wave length and consequently less penetrating.

If electrons could reach the anode at a speed equal to the beta particles of radium, it would seem that we would be able to generate roentgen rays whose wave lengths would be as short as the gamma ray of radium. (Fig. 4.)

DISCUSSION

Dr. Heber Robarts, Belleville, Illinois.—I have always been of the opinion that science, of which physics is a branch, should be obscure only to those in pursuit of phenomena. Once a thing discovered and understood the laws should be made plain to every one.

Contrary to the notion that a current of electricity runs through a wire from the generating apparatus is that the current is always there. Of course, the current is the electron and the electron is at the cathode. The molecular composition of the conducting medium is accelerated and in ratio of their acceleration, together with the heating at the cathode, does the electron speed away. When the apparatus rests the electron is static and becomes kinetic the moment the current is generated.

In an x-ray machine the generating apparatus is at one end and the crookes tube at the other. The electron at the generating source does not leap through the wire to the cathode and thence to the anode—it simply pushes off the electron at the cathode. If the velocity of the electron is greater than 5,000 miles a second at the time it strikes the anode an etherial wave or electromagnetic wave is evolved which represents the roentgen ray. The striking effect of the electron, which is measured by the square of its velocity, determines the speed and number of x-rays. The speed of electron in a good working hard x-ray tube is 10,000 miles a second.

At the moment of transformation of an atom of radium there is discharged an alpha particle and an emanation; and the emanation in its several periods of transformation expels alpha particles, discharges beta particles and radiates gamma rays. The beta particle is the electron and has a speed of 150,000 miles a second; the gamma ray has the speed of light with the phenomenon of constancy. It has a short wave length which gives it a penetrating power one hundred times greater than any other known ray.

There is discharged from a good working hard crookes tube 1,000,000 x-rays every second of time. From a gram of radium there is radiated 3,000,000,000 gamma rays every second of time and with mathematical constancy.

Now the striking effect of a particle of matter is not proportional to its velocity, but the square of its velocity. Then the electron which causes the x-ray in a crookes tube moving at a rate of 10,000 miles a second, and the beta particle which causes the gamma rays moving at the rate of 150,000 miles a second, then the beta particle strikes with an energy 225 times greater than the electron.

Dr. B. H. Orndoff, Chicago (closing).—There is nothing to say in closing other than to reiterate that the roentgen rays consist not in the discharge of particles from the anode, but that it represents waves or kinks in electrical force lines and that these waves or roentgen rays are light waves. The rays of light generated at the anode in a tube from the sun or from any other apparatus are waves in electrical force lines and that they travel at the same speed. The quality of light depends entirely upon the wave length. There is much to be said about the different kinds of light designated as roentgen rays, but the scope of this paper will not permit me to speak further of that at this time. I wish in closing to express my gratitude to Dr. Robarts for the discussion he gave my paper.

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EDITORIALS

Stepping Out in Front

RECENTLY, while a member of a party composed of men who belonged to the Rotary Club we attended a theatrical party. Among the Rotary members was a theatrical producer who during the performance enlightened us very materially upon the life history of some of the theatrical people. One of the performers was a young lady, very well known in the theatrical world not only for her ability as a performer, but because of the rapid rise in her profession. The theatrical producer was familiar with her professional life from the time she had entered upon the stage until the present time and described her success as being due to the fact that as a member of the chorus she was continually "stepping out in front."

We were enlightened as to the fact that "stepping out in front" among the

theatrical people when applied to a chorus girl described a condition of the individual who has a certain amount of ability and ambition and instead of staying back in the line even with the rest, insists upon displaying that ability by getting a few feet ahead of the legitimate chorus. This may be rudely termed "nerve" when not accomplished with ability, but when accomplished with ability is very soon recognized by the theatrical producers and the individual is given an opportunity to display her real talent and ability. As a result of this, the particular young lady in question is now playing a leading role, leading the same chorus which she was formerly a member of, all because of the fact that she insisted upon "stepping out in front."

When we consider the dental profession as a whole, we are surprised at the large number of individuals who are content to stay in the background and play a minor part in the development of their profession and never once have the ambition or ability to "step out in front." It has been said by a great many writers that there is plenty of room at the top, and we can truthfully say this in regard to the advancement in the dental profession; there is plenty of room for men out in front. For a number of years we have observed dental college work, and have seen class after class graduate and go into the practice of dentistry. The majority of them have been a success in so far as they have been able to make a better livelihood in the practice of the profession than they could in any other line of work. However, the majority of men have been failures so far as showing any real ability in leading the profession and distinguishing themselves by "stepping out in front." We have seen men who criticized the dental profession, found fault with the profession they were following, and even have gone so far as to belittle the profession because they have not been satisfied with their position. The reason they occupy that position is because they have placed themselves in it.

The dental profession, like the theatrical profession, has plenty of room for the individual who has the ability and the ambition to "step out in front." We realize it may require a large amount of hard work, because nothing that is worth while ever came without extraordinary effort. If you stop to consider the men in the dental profession who have attained international reputations for their ability and if you were permitted to know the inside history of why they have succeeded, you would find it has been because they have never been content to play a minor role and always bent their efforts towards doing something a little better today than they did yesterday. Each day they have tried to improve their efforts and tried to grasp opportunities and do something that would be worth while to themselves, and in doing that they have invariably produced something worth while to dentistry.

We have very little excuse for the man who is dissatisfied with his position and still willing to keep a position in the "back line" instead of exerting himself and making himself capable of playing a principal part by "stepping out in front" of the masses and demonstrating that he has an ability greater than the ordinary individual. We believe there is no line of work or profession in which a man's ability is so readily recognized by his fellow workers and by the public as in dentistry. In certain commercial lines men are able to advance only as they succeed in showing their ability to the men who are superior or above them. In the

dental profession there are no superior individuals, each man is allowed to work out his own salvation and when he shows ability,. he is immediately recognized by his coworkers and he does not have to satisfy any superior officer. Not only is his ability recognized by his coworkers, but it is immediately recognized by the public and consequently the position the man occupies in the dental profession is the position that he makes for himself. We wish we could make every young man realize the opportunities he has for advancing himself in his profession, and that those advancements depend upon him entirely; if he would succeed, he must keep this one thing in view; namely, to demonstrate his ability to the profession and the public by "stepping out in front."

Modern Dentistry*

THE name of this book, "Modern Dentistry," suggests that it deals with the subject of dentistry as practiced at the present time. The title to a certain extent is misleading as it should be "Head on Modern Dentistry" because the entire volume is a treatise of the author's ideas rather than a treatise of the subject of modern dentistry. We agree practically with everything that is written in the book especially the statement in which he says: "Henceforth no appliance however beautiful externally shall be tolerated unless it can be kept absolutely clean, and no repair of a tooth or root will be countenanced unless it conforms to the standard of scientific mouth hygiene." He also makes a plea for better trained dentists along medical lines by the following statement: "Dentists henceforth must be trained along medical lines and any contention that has existed in the past between physicians and dentists must disappear in a common endeavor to free the community at large from the deadly effects of mouth infection. For this disease is now recognized as an almost universal one; that every year directly or indirectly by the hundreds of thousands and it is the author's hope that this book will be of some service in its cure and prevention." The question may naturally arise whether mouth infection may be classed as a disease in itself any more than any type of infection may be considered a disease. Probably if we take the broader view of this proposition any tissue when it loses its normal function is a diseased tissue, and in that respect we can consider mouth infection a disease.

The first chapter deals with the cause and effect of mouth infection and contains a great many points of interest most of which we can agree with. We are especially pleased with the attitude that the author takes in considering mouth infection from both a systemic and local standpoint. In times past there has been a tendency when writing upon mouth infection to consider it either as a local proposition or go to the other extreme and consider it entirely from a systemic point, when as a matter of fact there is such a close correlation between the systemic and local cause and effect of mouth infection that it is very difficult to say in some cases which one is the cause and which the effect. In some instances mouth infection may be the cause of systemic disturbances and in other

*Modern Dentistry, by Joseph Head, M.D., D.D.S., Dentist to the Jefferson Hospital, Philadelphia, Pa. 374 pages, 309 illustrations. Published by W. B. Saunders Company, Philadelphia, 1917. Cloth, $5.00.

conditions systemic disturbances may precede the mouth infection. These views as explained by Doctor Head are worth the attention of any one and if the book contained nothing but the first and second chapters, it would be a valuable addition to any library.

In considering the conditions which cause mouth infection, we must note, however, that the author has omitted malocclusion as a contributing factor of mouth infection, for it is the opinion of a great many men at the present time that malocclusion is one of the greatest causes of mouth infection. Also as a preventive of mouth infection he fails to give the proper importance to the protective influence of the epithelial tissue which is the greatest means of protection from and prevention of the invading of microorganisms that we have. Practically all cases of infection that we find are the result of some break in the epithelial structure from some cause, thereby permitting the microorganisms to invade the underlying tissues. The use of the silk floss and brush is explained in detail which also is a valuable portion of the book.

Chapter III deals with the study of tooth enamel and saliva, and gives a large number of experiments carried on by the author in regard to softening and hardening of the enamel. These experiments are very interesting and the author seems to hold the opinion that the normal saliva has a very beneficial effect upon the enamel of the teeth.

The various plans of the treatment of mouth infection are taken up, including the local and systemic treatment, the use of bacterial vaccines and the use of bifluoride of ammonium compound in the softening of tartar and the scaling of teeth. This latter method has been written on and advocated by the author a great many times in dental journals in the last few years and in our mind possesses a great many advantages over other methods.

Chapter VI deals with the treatment of root canals, alveolar abscesses, and similar conditions. In conjunction with the consideration of the treatment of root canals the author calls attention to the experiments made by Dr. Gies of Columbia University which tends to prove that the tooth is nourished through the medium of the peridental membrane and that a tooth in which the pulp has been removed is by no means a dead tooth as is contended by a number of the dental and medical profession at the present time. We are very pleased to note this for we have long contended that a tooth with the pulp removed can still be a serviceable tooth and must not be considered as a foreign element as some of the profession have told us at times. A quotation from Dr. Head's work follows: "Such a tooth is very much alive and should not be looked upon as dead but as a living member capable of performing its various functions."

The chapter on Fillings is decidedly the idea of Dr. Head on the subject and he takes the position that will be disagreed to by a great many men; namely, the universal condemning of malleted gold fillings. It is a fact, as he states, that a great many gold fillings with perfect edges have lasted over fifty years, but it is also a fact that a great many more did not last one-tenth of that time. We believe that his plea for the inlays both of gold and porcelain and the use of cement and proper cavity preparation is in keeping with the ideas of modern dentistry. The thing which we would criticize both in the chapter on fillings and on crowns is the poor illustrations. Most of the illustrations have very little

resemblance to anatomic tooth forms and very little attention is paid to the function of the tooth form. The illustrations of the various crowns fail to show the anatomic contour and the proper reconstruction of the gingival marginal ridges which are very important factors if the crown is to perform its physiologic function.

There is a chapter on the care of children's teeth, a portion of which is devoted to the subject of orthodontia. The orthodontic portion is written from the standpoint of a general practitioner, but can hardly be classed as modern orthodontia. Most of the appliances which are shown are more or less obsolete at the present time, and the models are such as are generally made by the average dental practitioner. The treatments advanced may be the proper orthodontic treatment and in that respect it is a valuable addition to the book.

The replacement of lost teeth by various forms of attachments is considered and there is also a chapter concerning experiments on various cements. Chapter XII deals with the study of the roots and gums by means of the x-ray, and a number of very interesting cases are shown. The book as a whole contains many valuable points and a great many theories are set forth with which probably some readers will not wholly agree. The book is one which should be recommended more to the general practitioner than to the dental student, owing to the fact that it is simply a treatise on modern dentistry from Dr. Head's standpoint, and as such we would recommend it to any one who is capable of thinking clearly upon a certain subject. The value of any book lies not so much in the fact that you agree entirely with what the author says, but that he succeeds in making you think more deeply upon the subject than you have in times past.

Our Hawaii

THAT large group of Americans who have not been privileged to visit Hawaii are under obligations to Charmian Kittredge London for the interesting and valuable information she has given to them in her recent book, "Our Hawaii" (The Macmillan Company, New York).

The Londons, Jack and Charmian, knew our Island States, the Hawaii group, as few Americans are privileged to know it. It was their playground. They acquired an intimacy with it and with its people during the months spent voyaging inland and cruising around its coast line, and this knowledge the author has set forth most interestingly to her readers.

Mrs. London has done more than write a book of travels about these islands and their people. She has given a dissertation, reliable and scientific, upon an integral part of our country—a part, let it be said, of which the average American knows but little. Most of us are familiar, by tradition at least, with the wooden nutmegs of the Connecticut Yankee, the flannel sausages of the Vermonter, the barbecued meat of the Southern planter, and the rodeos of the Texas rancher, but how many of us know anything about the beautiful but simple customs of the Hawaiians, their large and generous hospitality, the friendship and devotion they show to the stranger within their gates. Of all these things Mrs. London writes interestingly and well.

The author's style is deserving of special notice. In a book of this character imagination is brought but little into play. It chronicles actual happenings, and these frequently are commonplace and make dry reading, but like the French chef who disguises unpalatable foodstuff with tasty sauces and attractive garnishings, so does a charming and attractive style dress up a narrative that otherwise would not attract. Mrs. London has a style that is all her own. It reminds one of the nip and exhilaration of champagne that has ripened in some dark and musty cellar in immortal France. It is said that one soon forgets the gaudy butterfly, but the remembrance of the bee with its sting remains. Mrs. London's style makes an impression so deep upon one that it is not easily forgotten. "Our Hawaii" is one of the real literary gems that has appeared within the last twelve months. After reading it one is prone to murmur the immortal words of Leigh Hunt: "May thy tribe increase."

American Society of Orthodontists

THE Eighteenth Annual Meeting of this Society was held in Chicago, August 1, 2 and 3, 1918, under the presidency of Dr. D. Willard Flint, Pittsburgh, Pa.

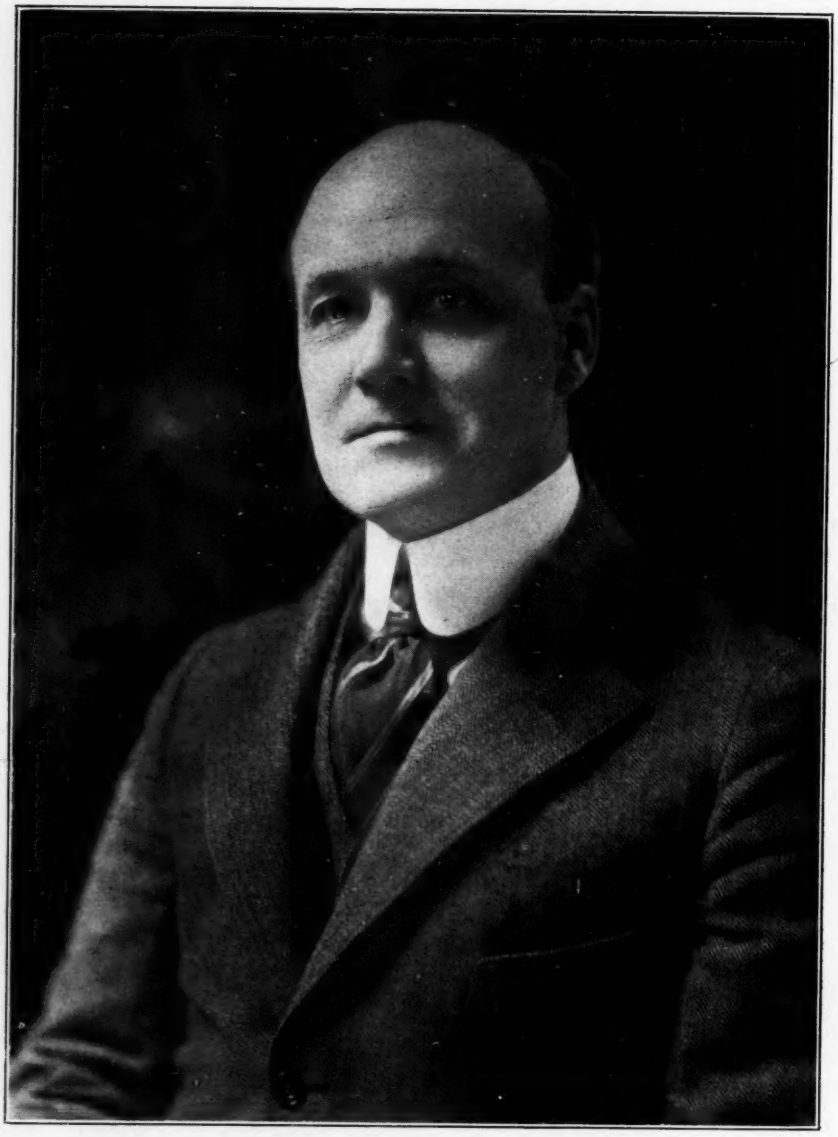
Interesting papers were read and freely discussed. A new constitution and by-laws were adopted.

The following is a list of papers read at this meeting:

"The Forces that Influence Structural Development of the Face," by Dr. Alfred P. Rogers, Boston; "A Consideration of Some Principles of Appliances," by Dr. Martin Dewey, Chicago; "The Law of Occlusion," by A. LeRoy Johnson, Springfield, Mass.; "The Removable Lingual Arch as an Appliance for the Treatment of Malocclusion of the Teeth," by John V. Mershon, Philadelphia; "Democratizing Dentistry," by Dr. Allen H. Suggett, San Francisco; "Radical Tooth Movement," by Dr. Ray D. Robinson, Los Angeles; "What Orthodontia and Orthodontists Have to Offer to Our Own as Well as Allied Sciences," by Dr. B. W. Weinberger, New York; "Orthodontia Metals and Alloys; the Metallurgy, Constitution and Physical Properties of Dental Gold Alloys, and their Special Application in Orthodontia," by Mr. Louis J. Weinstein, New York; "Stereoscopic Roentgenology," by Dr. C. Edmund Kells, New Orleans; "The Teaching of Orthodontia to Undergraduates," by Ralph Waldron, Newark, N. J.

The following officers were elected: President, Dr. O. W. White, Detroit, Michigan; President-Elect, Dr. John V. Mershon, Philadelphia; Secretary, Dr. F. M. Casto, Cleveland, Ohio; Treasurer, Dr. Bert Abell, Toledo, Ohio; Board of Censors: F. C. Kemple, New York City, Chairman; M. N. Federspiel, Milwaukee, Wisconsin; and Lloyd S. Lourie, Chicago.

St. Louis, Missouri, was selected as the next place of meeting, and the time of holding the meeting to be fixed for the last week in February or the first week in March, 1919.



OLIVER W. WHITE, D.D.S.,
President of the American Society of Orthodontists, 1918